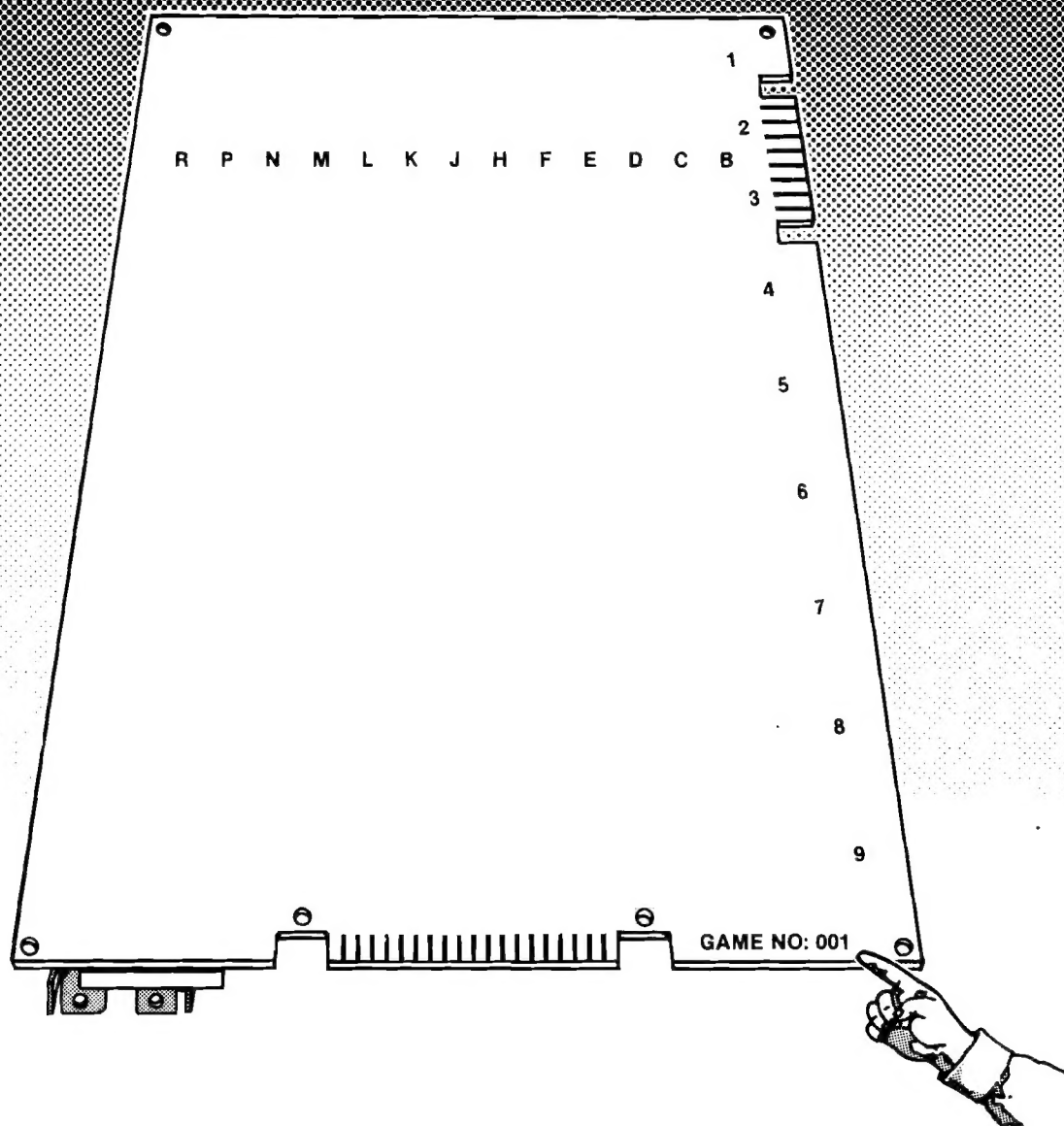




Operation, Maintenance and Service Manual  
Complete with Illustrated Parts Catalog



## GAME SERIAL NUMBER LOCATION

Your game's serial number is stamped on the circuit (back) side, bottom right corner, of the printed circuit board—see the illustration below. The *same* number is also stamped on the label located on the rear of the game cabinet. Please mention this number whenever calling your distributor for service.

# **Smokey Joe™**

## **Operation, Maintenance and Service Manual**

Complete with Illustrated Parts Catalog

ATARI INC  
1265 BORREGAS AVENUE  
P.O. BOX 9027  
SUNNYVALE, CALIFORNIA 94086  
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## TV MONITOR SERVICING INFORMATION

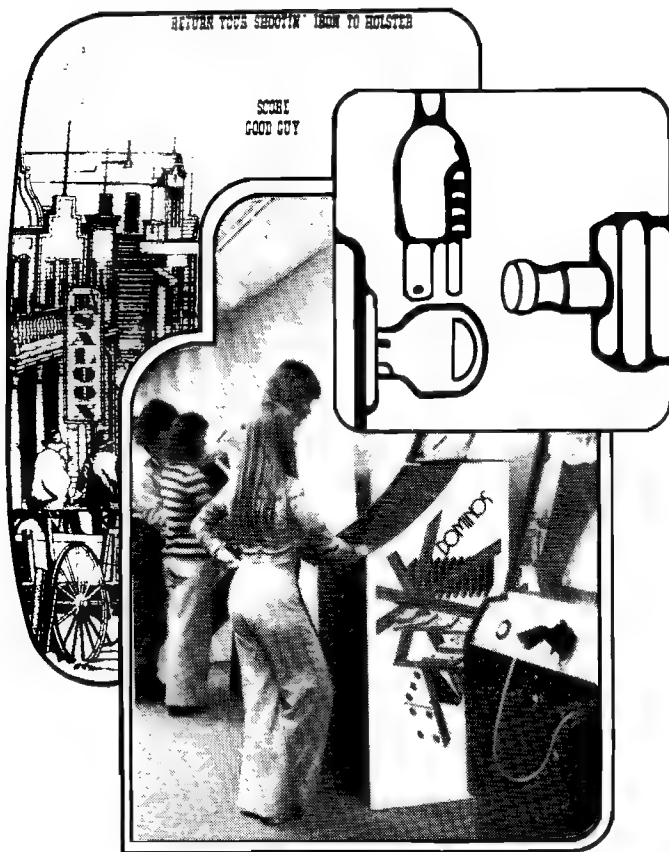
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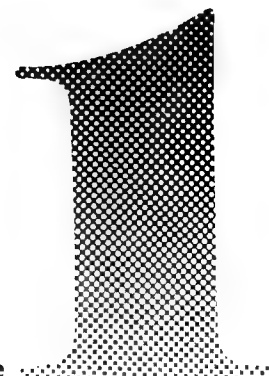


# LOCATION SETUP

## A. INTRODUCTION

SMOKEY JOE is a one-player driving game which is packaged in a distinctively styled upright cabinet that rests directly on the floor. A 23-inch TV monitor is mounted in the top front of the cabinet, with the monitor viewing screen slightly tilted from the vertical. Player-operated controls are mounted directly below the TV monitor viewing screen on the front of the game cabinet. The controls consist of a steering wheel, an accelerator foot pedal, a pushbutton for track difficulty, a front start pushbutton, and a back start pushbutton.

Two identical coin mechanisms are mounted on the lower front center of the game cabinet, below the steering controls. Either of these two mechanisms can initiate play. The cash box is located behind a locked access door below the coin mechanisms.



Smokey Joe

The player's objective is to manipulate the Smokey Joe firetruck along the track in a race against time. The player must avoid sliding in oil pools in the road, or dropping into sand pits, as well as avoiding other cars, while keeping the Smokey Joe firetruck within the boundaries of the road. The player has the option of driving either the cab or the tail.

Acceleration is as in a real firetruck with cab to tail "cooperative" interaction. Accelerate slowly. If the firetruck goes into an oil slick or sand pit, it slides, with sound of sliding from the game cabinet speaker. If the firetruck drives into a track boundary, a tree, or another car, a crash sound will be heard from the game cabinet speaker and the TV monitor viewing screen will flash.

## **B. GAME INSPECTION**

Follow the procedures below to ensure that your game is in perfect condition.

1. Examine all external parts of the game cabinet for dents, chips, or broken parts.
2. After determining that the game has been received in good condition, unlock and open the rear access door. Carefully inspect the interior and verify that:
  - All plug-in connectors are firmly seated.
  - All integrated circuits in sockets on the game printed circuit board are firmly seated.
  - The fuses are all seated in their holders.
  - No harness wires are disconnected.
  - No loose foreign objects are present, especially metal objects that could cause electrical problems.

Be sure all major assemblies are checked. Check the game printed circuit board (PCB), the transformer, the two coin mechanisms, the speaker, the fluorescent light, and the player controls. Also, be sure the TV monitor is secure in its mounting.

## **C. LOCATION OF SERIAL NUMBER**

The serial number for Smokey Joe is located on a metallic label in the upper left-hand corner on the back of the game cabinet. This serial number also appears in the corner (common to both edge connectors) on the back of the PCB, inside the game cabinet. See the illustration on the inside front cover of this manual.

## **D. INSTALLATION REQUIREMENTS**

Smokey Joe is shipped for operation at 110 VAC, 60 Hz. Power consumption is approximately 150 watts. However, if your local voltage is not 110 volts, follow this procedure. You must select one of four connectors at the power supply and plug it into the voltage selection socket. Figure 1-1 shows the four connectors with one of them plugged in. The plugs are identified by wire color as listed in this figure. Note that there are two basic operating voltages — 110 VAC, 60 Hz, and 220 VAC, 50 Hz, with provisions for low line voltage in each case. To insure proper operation, measure line voltage. If voltage is consistently below 100 V (for 110 VAC lines) or consistently below 210 V (for 220 VAC lines), use the low-voltage connections. Use the black plug for low 110 VAC lines and the green plug for low 220 lines.

### **Temperature Range**

Location and storage should not be below 0 degrees Celsius (32 degrees Fahrenheit), and no higher than 49 degrees Celsius (120 degrees Fahrenheit).

### **Humidity Range**

Relative humidity for location or storage should be no more than 95%

### **Location Space Requirements**

The game requires a minimum of:

- 168 centimeters (66 inches) of vertical clearance
- 65 centimeters (25.5 inches) of width space
- 175 centimeters (69 inches) of depth space  
See Figure 1-2 for details.

### **Type of Power Cord**

Atari has added a strain relief power cord to Smokey Joe. The advantage of this type of power cord is that, if pulled accidentally, the strain relief will hold the cord in place at the pedestal base. The plastic strain relief "cushions" the impact of the shock and prevents the cord from pulling the wires out of the harness connector. Check the power cord assembly periodically for damage.

| LINE VOLTAGE | VOLTAGE-CHANGING PLUG WIRE COLOR |
|--------------|----------------------------------|
| 95 VAC       | BLACK                            |
| 110 VAC      | ORANGE<br>(installed at factory) |
| 210 VAC      | GREEN                            |
| 220 VAC      | RED                              |

**NOTE:**  
Power supply in your game may not include fuses F3, F4, and F5.

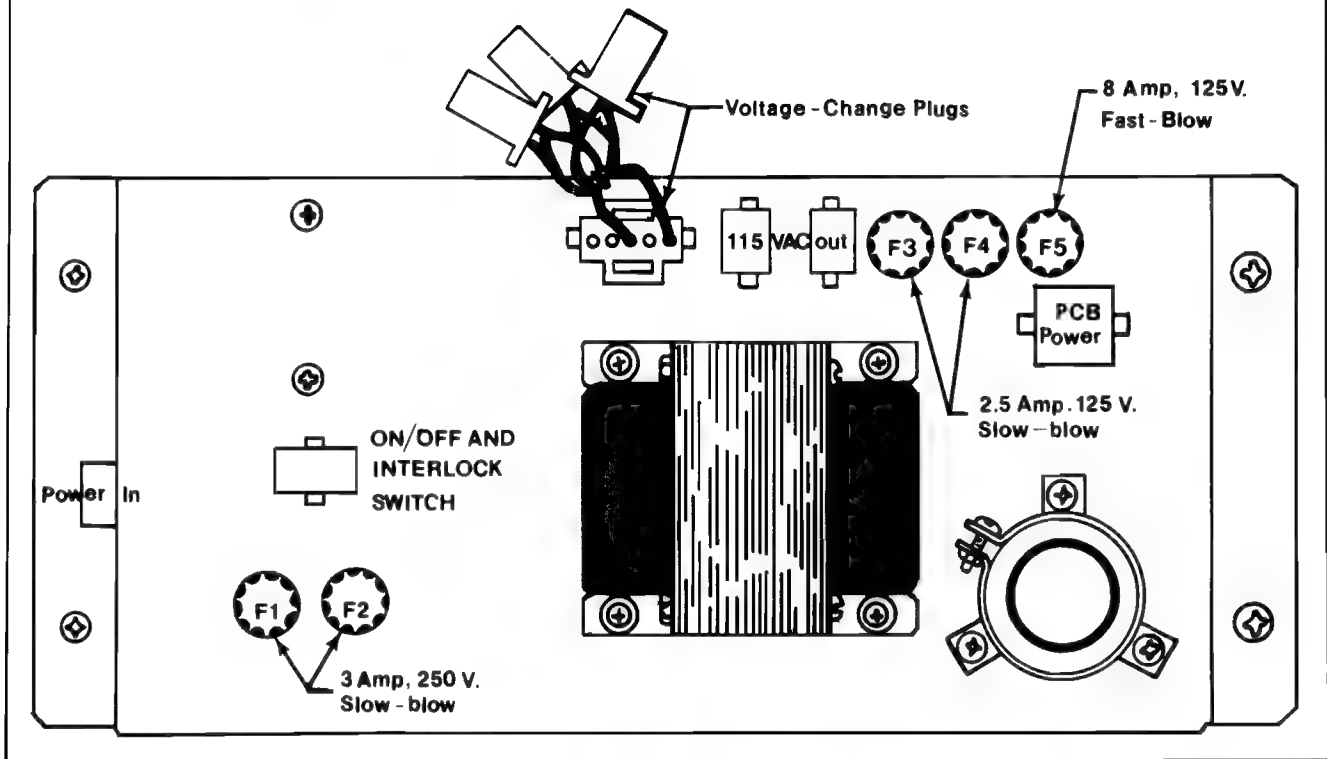


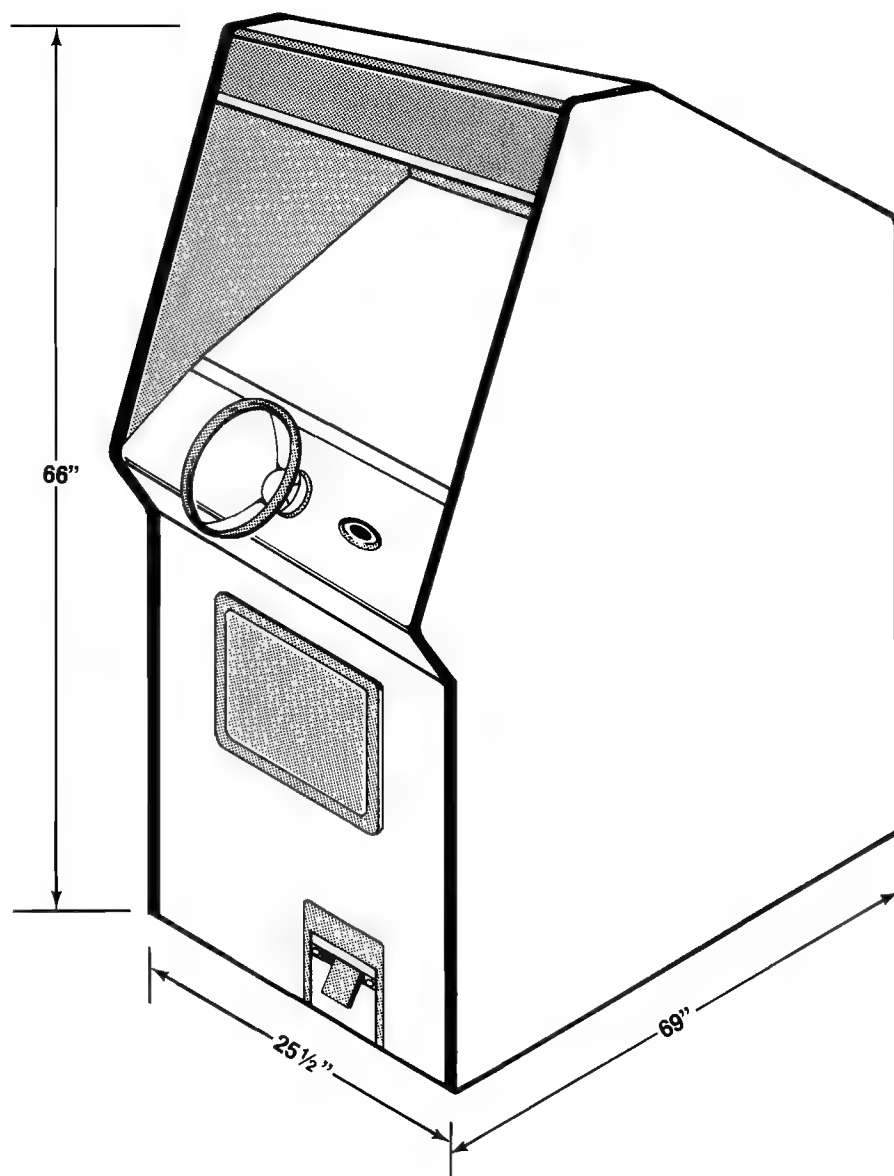
Figure 1-1 Location of Voltage-Changing Plugs on the Power Supply

## E. INTERLOCK AND POWER ON/OFF SWITCHES

To minimize the hazard of electrical shock while you are working inside the game cabinet, two interlock switches have been installed at the rear door assembly and at the coin door. These switches remove all power from the game while the doors are open. To help you conserve energy, a power on/off switch has been installed on the game so that it can be turned off during closed periods. This switch is located at the rear of the upright cabinet toward the top, as shown in Figure 1-3.

Check for proper operation of the interlock switches by performing the following steps:

1. Unlock and open the rear door assembly and the coin door.
2. Plug the AC power cord into a 110-volt source. (If voltage is consistently less than 110 VAC, make sure that you use the black plug instead.)
3. Set the power on/off switch to the *on* position.
4. Close both doors. Within approximately 30 seconds the TV monitor should display a picture.
5. Slowly open each door until the TV monitor picture disappears. The picture should disappear when the rear door is opened less than one inch from the top.
6. If the results of Step 5 are satisfactory, the interlock switches are operating properly. If the picture does not disappear as described, check to see if the ap-



**Figure 1-2 Location Space Requirements**



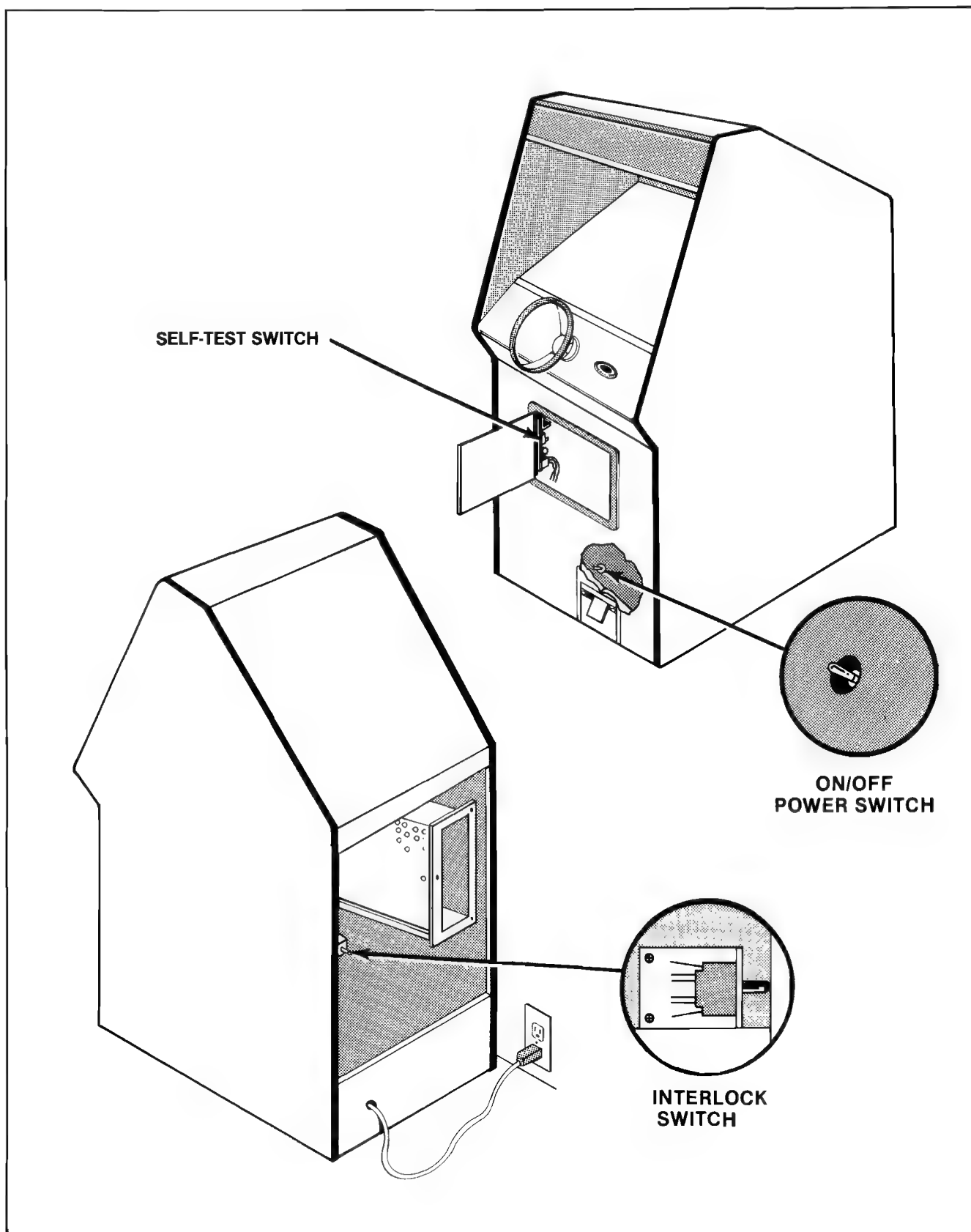
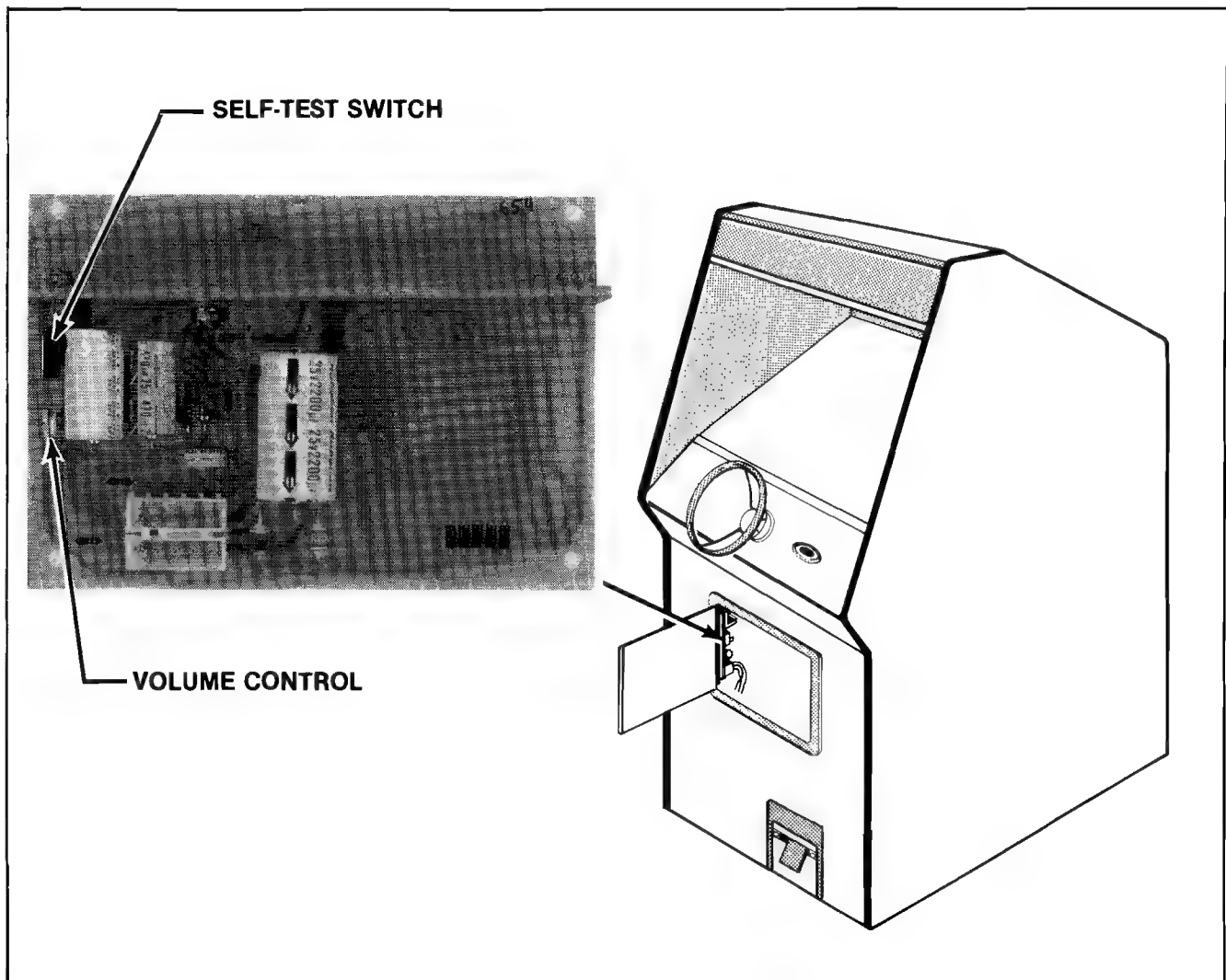


Figure 1-3 Location of Interlock and Power On/Off Switches



**Figure 1-4 Location of Volume Control and Self-Test Switch**

appropriate switch is broken from its mounting or stuck in the on position.

7. Close and lock both doors.

## **F. VOLUME CONTROL**

If volume is incorrect for your location, open the coin door and adjust the volume control. See Figure 1-4 for location of the volume control.

## **G. SELF-TEST PROCEDURE**

Smokey Joe will test itself and provide data to demonstrate that the game's circuitry and controls are working properly. This procedure uses the TV monitor and the speakers; no additional equipment is required. SEE FIGURE 1-4 FOR LOCATION OF THE SELF-TEST SWITCH. To start the procedure over from the begin-

ning, turn the switch off, then on again. This will return the test to Step 1 and can be done at any time during the procedure. See Table 1-1 for further details and instructions on the self-test. We suggest that you run the self-test procedure each time the coin box is emptied.

## **H. OPERATOR OPTIONS**

Options of the Smokey Joe game offer maximum player appeal for each game location. These options are listed in Table 1-2. They are preset for a certain game setup during production. To determine how the switches have been set for your game, compare the TV monitor viewing screen during the attract mode with the information in Table 1-2.

To change the toggle positions of the switch assembly and set the desired options, the printed circuit board (PCB) must be removed according to the following procedure.

**NOTE**

The Smokey Joe game includes a new style of easy-access PCB. The radio frequency shield has been redesigned to use only three quarter-turn fasteners—as a direct result of field input.

1. Unplug the game. Unlock and open the rear door assembly.
2. Locate the radio frequency (RF) shield assembly immediately inside the cabinet on the right. See Figure 1-5. On one end of the box is a printed circuit board (PCB) with an edge connector coming from the edge of the board. (The RF shield assembly is an aluminum box with small holes.)
3. Turn the three quarter-turn fasteners on the RF Shield assembly by turning the wing nuts  $\frac{1}{4}$  turn.
4. Carefully pull out the PCB and the RF shield board as one unit. These would *not* normally need to be separated when making option switch changes.
5. Set the switches for the desired options, as shown in Table 1-2.
6. Reinstall the PCB following steps 1 through 4 in reverse order. Do not force or bend the printed circuit board. Before reinstalling, always inspect the PCB for damage. Close and lock the rear access door.
7. Plug in the game and verify options functions by playing it.

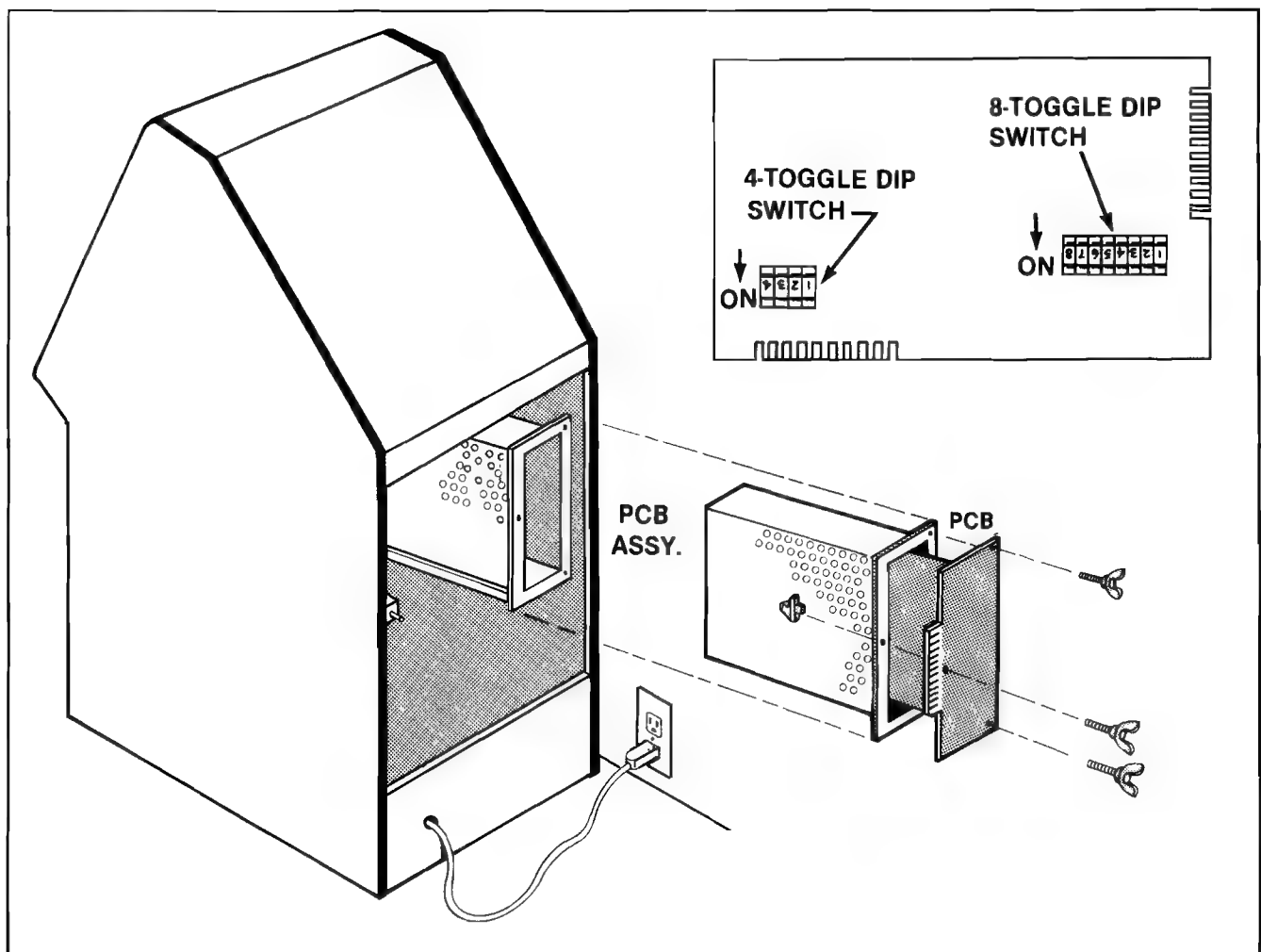
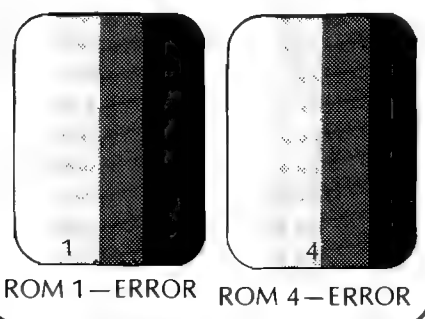
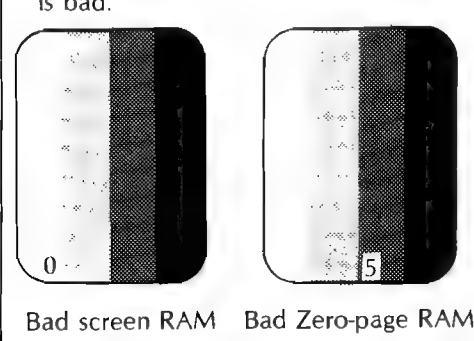


Figure 1-5 Option DIP Switches on Game PCB

**Table 1-1 Self-Test**

| TEST | INSTRUCTION   | RESULTS IF TEST PASSES   | RESULTS IF TEST FAILS   |
|------|---|--|---|
| 1    | <p>Unlock and open the coin door. Locate the self-test switch and turn to the "on" position.</p> <p>The ROM and RAM test will follow</p>  | <p>There are four ROM s programmed into Fire Truck. If they all check satisfactorily, there is no visible change or indication on the TV screen.</p> <p>Throughout the self-test, a set of stationary graphics appear in a rainbow pattern (dark to light) from the left side to the right side of the screen.</p> | <p>1, 2, 3 and/or 4 is displayed in the lower left corner of the TV screen. These numbers correspond to the failing ROM or ROM s.</p> <div data-bbox="974 510 1396 829">  </div> <p>These examples represent two of the possible four ROM s which could be in error.</p> <p>If the zero-page RAM is bad, a 0 is displayed in the lower left corner of the screen. A 5 is displayed if the screen RAM is bad.</p> <div data-bbox="958 1106 1429 1447">  </div> |
| 2    | <p>The next phase of the self-test checks the LED switches and both steering wheels on each control panel.</p> <p>Individually press the six LED switches.</p> <p>Turn each steering wheel to the right, then back to the left. Then reverse the procedure.</p> | <p>The LED's are on.</p> <p>An electronic "pop" sound occurs each time a switch is pressed, and again when the switch is released.</p> <p>The same pop sound occurs each time there is a change in (the) direction in which the wheel is being turned.</p>   | <p>No sound indicates a stuck or broken switch, or an open or shorted harness.</p>  |
| 3    | <p>Trip the right and left coin switch wires.</p>   | <p>The pop sound occurs whenever a coin switch wire is tripped.</p>  |   |

**Table 1-2 Operator Options**

| OPTION         | 8-TOGGLE DIP SWITCH ON GAME PCB —TOGGLE NO:  |   |     |     |                                      |   |                                      |   |
|----------------|--|---|-----|-----|--------------------------------------|---|--------------------------------------|---|
| EXTENDED PLAY* | 1  | 2 | 3   | 4   | 5                                    | 6 | 7                                    | 8 |
|                | NOT<br>USED                                  |   | ON  | ON  |                                      |   |                                      |   |
|                |  |   | ON  | OFF |                                      |   |                                      |   |
|                |  |   | OFF | ON  |                                      |   |                                      |   |
|                |  |   | OFF | OFF |                                      |   |                                      |   |
| GAME TIME      | NOT<br>USED                                  |   |     |     | ON ON<br>ON OFF<br>OFF ON<br>OFF OFF |   |                                      |   |
| 60 Seconds     |  |   |     |     |                                      |   |                                      |   |
| 90 Seconds     |  |   |     |     |                                      |   |                                      |   |
| 120 Seconds    |  |   |     |     |                                      |   |                                      |   |
| 150 Seconds    |  |   |     |     |                                      |   |                                      |   |
| GAME LANGUAGE  |  |   |     |     |                                      |   | ON ON<br>ON OFF<br>OFF ON<br>OFF OFF |   |
| English        |  |   |     |     |                                      |   |                                      |   |
| French         |  |   |     |     |                                      |   |                                      |   |
| Spanish        |  |   |     |     |                                      |   |                                      |   |
| German         |  |   |     |     |                                      |   |                                      |   |
| OPTION         | 4-TOGGLE DIP SWITCH ON GAME PCB —TOGGLE NO.: |   |     |     |                                      |   |                                      |   |
| GAME COST      | 1  | 2 | 3   | 4   |                                      |   |                                      |   |
|                | NOT<br>USED                                  |   | ON  | ON  |                                      |   |                                      |   |
|                |  |   | OFF | ON  |                                      |   |                                      |   |
|                |  |   | ON  | OFF |                                      |   |                                      |   |
|                |  |   | OFF | OFF |                                      |   |                                      |   |
|                |  |   |     |     |                                      |   |                                      |   |

\*See Table 1-3 for point scores required to earn extended play.

**Table 1-3 Points Required to Earn Extended Play**

| Extended Play<br>Option Setting: | Game Length Setting                  |               |                |                |
|----------------------------------|--------------------------------------|---------------|----------------|----------------|
|                                  | 60<br>seconds                        | 90<br>seconds | 120<br>seconds | 150<br>seconds |
|                                  | Extended play granted for scoring... |               |                |                |
|                                  | 90 pts.                              | 140 pts.      | 190 pts.       | 240 pts.       |
|                                  | 100                                  | 160           | 220            | 270            |
| Liberal                          | 120                                  | 180           | 240            | 300            |
| Medium                           |                                      |               |                |                |
| Conservative                     |                                      |               |                |                |







## GAME PLAY

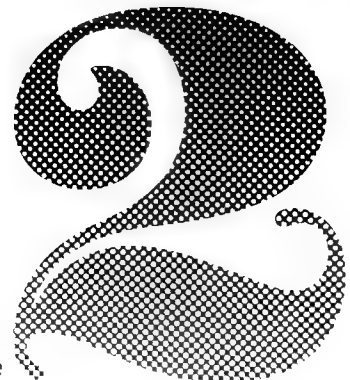
Smokey Joe has three modes of operation:

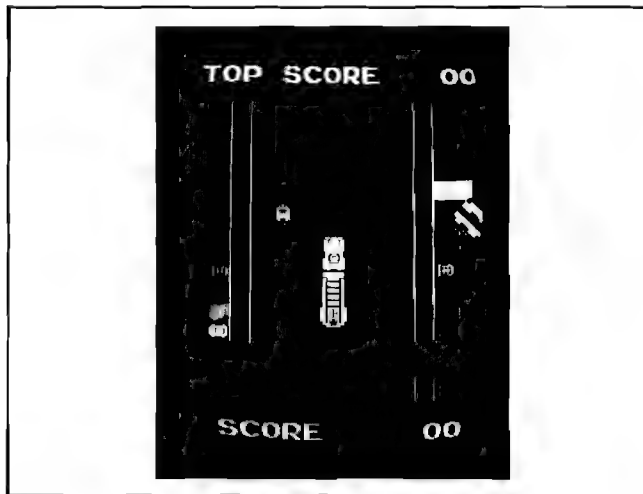
- Attract — power applied or at the end of a game
- Ready-to-Play — coins accepted
- Play — after one of the Start buttons is activated

### A. ATTRACT MODE (See Figure 2-1)

The attract mode begins when power is applied to the game and the power switch is turned on. (The power on/off switch is located at the back of the cabinet, as shown in Figure 1-2.) This mode also occurs at the end of every game. When the proper amount of coins clear the coin acceptor, the attract mode ends.

During the attract mode a firetruck is shown in the middle of the screen with the roadway scenery and hazards passing by. *BONUS* information and *TOP SCORE* information appear (alternately) at the top of the viewing screen. The previous game *SCORE* and driver rating message (*SORRY*, *SO-SO*, *GOOD* or *ACE*), appear alternately at the bottom of the screen. The player controls and game sounds are inactive during this mode.





**Figure 2-1 Attract Mode / Ready-to-Play Mode**

## **B. READY-TO-PLAY MODE (See Figure 2-1)**

When the correct amount of coins clear the coin acceptor, the ready-to-play mode is initiated. There is no change on the TV monitor from the attract mode. The Start buttons on the control panels flash on and off according to the amount of credit registered for the game. If there is sufficient credit for another game the front and back start button will flash.

It is during the ready-to-play mode that players have the opportunity to select the "Hard" or "Easy" track. If the track select button is lit, the hard track will be displayed for the duration of one game. The button has to be reactivated (lit) at the beginning of each game for the hard track to be displayed.

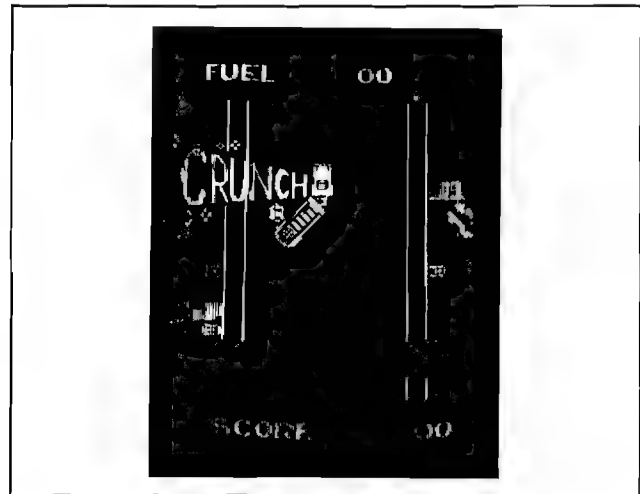
This mode also occurs at the end of game play if there are credits remaining.

## **C. PLAY MODE (See Figure 2-2)**

The play mode begins when one of the start buttons is pressed. The player steers either the cab or the tail.

*See Section H in Chapter 1 for various operator options (game time, cost, extended play levels, etc.)*

It is possible to influence the direction of one part of the firetruck by radically steering the other. For ex-



**Figure 2-2 Play Mode**

ample, if the cab is steered extremely to one side or the other, the tail steering will be hampered and a "static" noise will be heard over the game speakers.

The object of the game is to crash as little as possible, thereby obtaining a high point score. The front player operates the accelerator foot pedal.

Whenever any part of the firetruck comes in contact with the side of the road (sidewalk) or another obstacle, the TV monitor flashes, all motion freezes, a crash sound is heard over the speakers, and the word CRUNCH is displayed on the screen.

Points are awarded in increments of ten. Each time ten points are earned (by passing certain invisible points on the track), the sound of three ringing bells is heard over the game speakers. When extended play is earned, the track goes into a white video display for the remainder of such bonus time and the *EXTENDED PLAY* tone is heard. Other game sounds include the:

- Engine sound
- Siren sound
- Screech sound
- Horn sound
- Crash sound



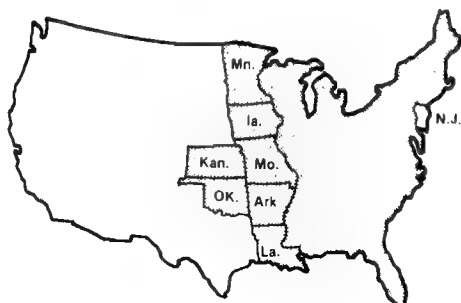
Due to its solid-state electronic circuitry, this Atari unit should require very little maintenance and only occasional adjustment. Information given in this chapter and elsewhere in this manual is intended to cover most servicing situations that may be encountered at a game site. The procedures given are in sufficient detail to be understood by a person with moderate technical background.

#### NOTE

If reading through this manual does not lead to solving a specific maintenance problem, you can get help from the following two Atari Customer Service offices

Atari/New Jersey Customer Service Office  
46 Colonial Drive, Piscataway, NJ 08854  
Telex 37-9347  
(Monday-Friday, 8:30-5 pm Eastern time)

Dial toll-free from anywhere in the shaded area on map below (800) 631-5374



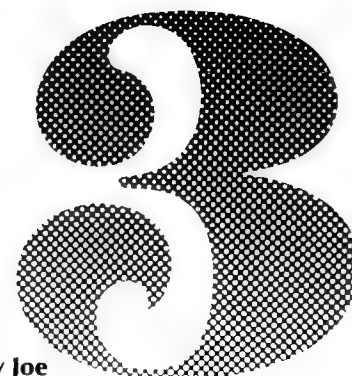
From New Jersey and elsewhere in the U.S. dial (201) 981-0490

Atari/California Customer Service Office  
1344 Bordeaux Drive, Sunnyvale, CA 94086  
Telex 17-1103  
(Monday-Friday, 7:30-4 pm Pacific time)

From California, Alaska and Hawaii dial (408) 745-2900

From the remaining 47 states, dial toll-free (800) 538-1611

## MAINTENANCE AND ADJUSTMENTS



Smokey Joe

## A. CLEANING

The exteriors of game cabinets and Plexiglas® panels may be cleaned with any non-abrasive household cleaner. If desired, special coin machine cleaners that leave no residue can be obtained from your distributor. Do *not* dry-wipe the acrylic plastic panels, because any dust can scratch the surface and result in fogging the plastic.

## B. COIN MECHANISM

### Components On Coin Door

Figure 3-1 shows the back side of the coin door assembly where the game's two coin mechanisms are mounted. Included is the lock-out coil assembly; the lock-out wires are connected to this assembly but are hidden behind the coin mechanisms. Powering the game causes the lock-out wires to retract far enough to allow genuine coins to reach the coin box. When AC power to the game has already been turned off, the lock-out coil is de-energized, causing the lock-out wires to move out far enough to divert coins to the return chute.

Directly below each coin mechanism is a secondary coin chute and a coin switch with a trip wire extend-

ding out to the front edge of the chute. When the trip wire is positioned correctly, a coin passing down the secondary chute and into the coin box will momentarily push the trip wire down and cause the switch contacts to close.

Also shown in the photograph is a slam switch assembly. It has been included to defeat any players who might try to obtain free game plays by violently pounding on the coin door to momentarily close the contacts on a coin switch. The slam switch contacts connect to the microcomputer system, which will ignore coin switch signals whenever the slam switch contacts are closed.

### Access to Coin Mechanisms

To remove jammed coins, and for maintenance cleaning, each magnet gate assembly can be hinged open without removing it from the door, as shown in Figure 3-2. Or, if necessary, each coin mechanism can be entirely removed from the door merely by pushing down on a release lever and simultaneously tilting the mechanism back, then lifting it up and out. This is shown in Figure 3-3.

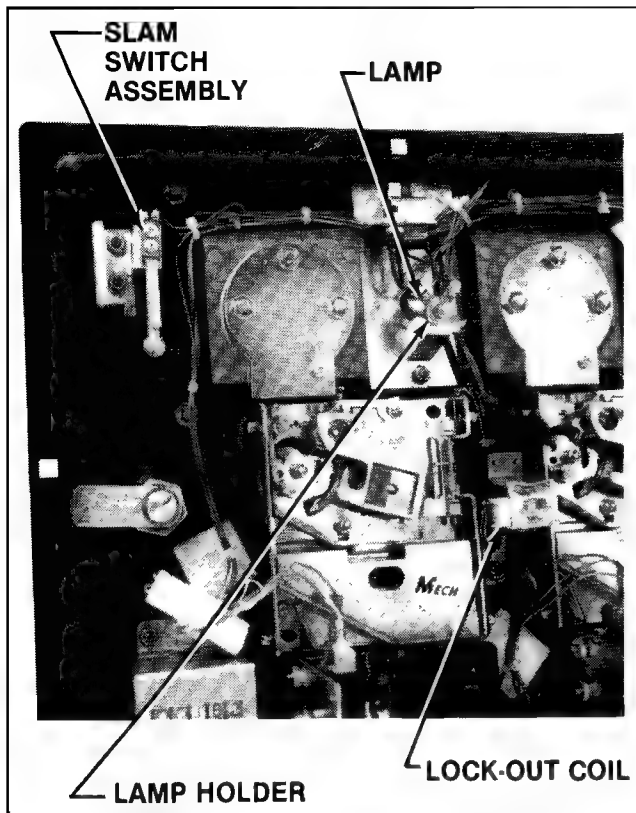


Figure 3-1 Coin Door Assembly

Plexiglas® is a registered trademark of Rohm & Haas Company.

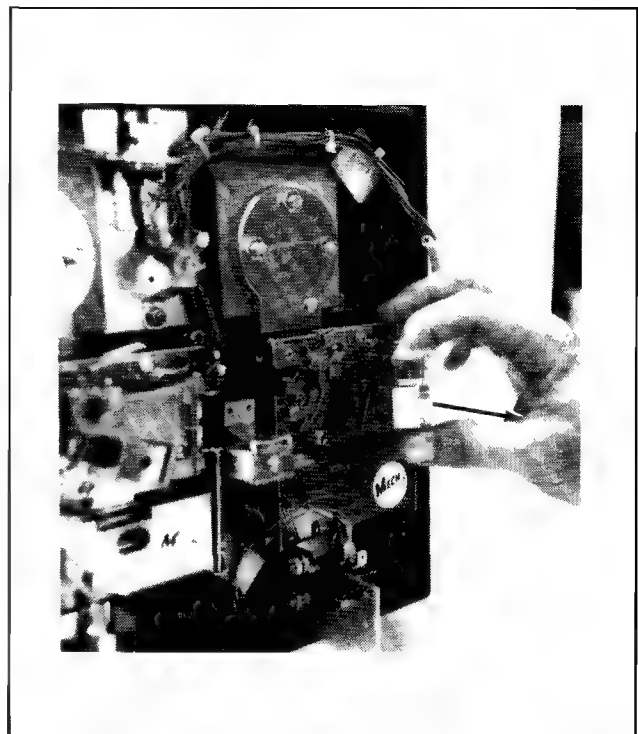
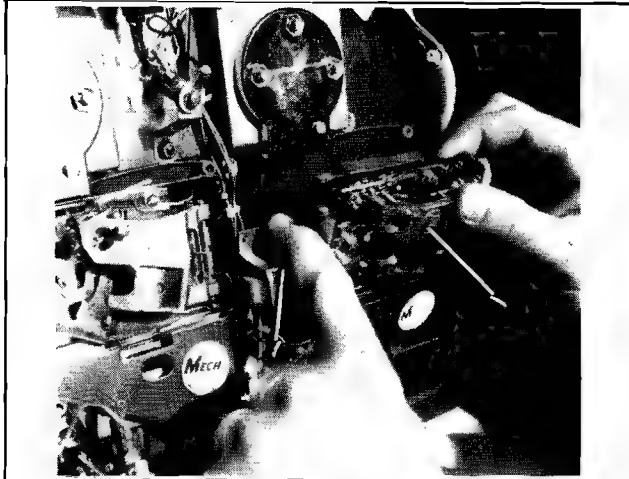


Figure 3-2 Hinging Open the Magnet Gate Assembly



**Figure 3-3 Removal of Coin Mechanism**

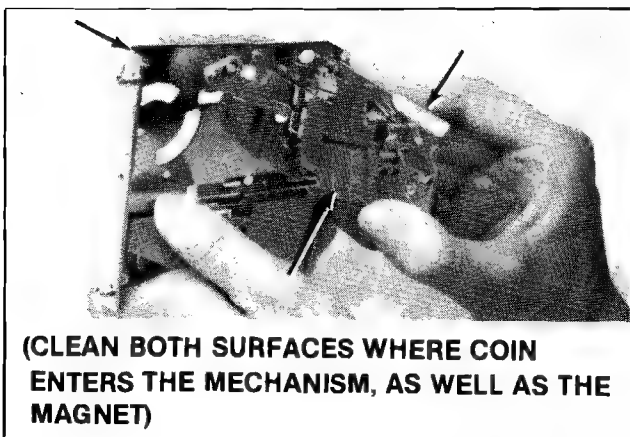
## Cleaning of Coin Paths

### CAUTION

The use of an abrasive (such as steel wool or a wire brush) or a lubrication on a coin mechanism will result in a rapid buildup of residue.

By talking to many operators, we have found that the best method of cleaning a coin mechanism is by using hot or boiling water and a mild detergent. A toothbrush may be used for those stubborn buildups of residue. After cleaning, flush thoroughly with hot or boiling water, then blow out all water with compressed air.

Figure 3-4 shows the surfaces to clean inside the coin mechanism. These include the inside surface of the

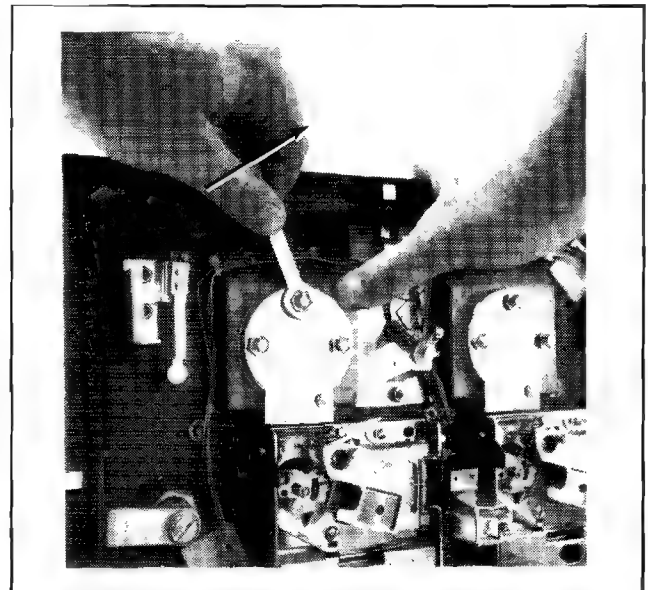


**Figure 3-4 Surfaces to Clean Inside the Coin Mechanism**

mainplate, and the corresponding surface of the gate assembly. There may also be metal particles clinging to the magnet itself. To remove these you can guide the point of a screwdriver or similar tool along the edge of the magnet.

If coins are not traveling as far as the coin mechanisms, you will need to clean the channel beneath the coin slot. To gain access to this channel, use a 3/8-inch wrench and remove all three nuts that secure the cover plate (refer to Figure 3-5). Removing the plate will provide access to the entire channel.

Also clean the inside surfaces of the secondary coin chutes, but when doing this be careful not to damage or bend the trip wires on the coin switches.



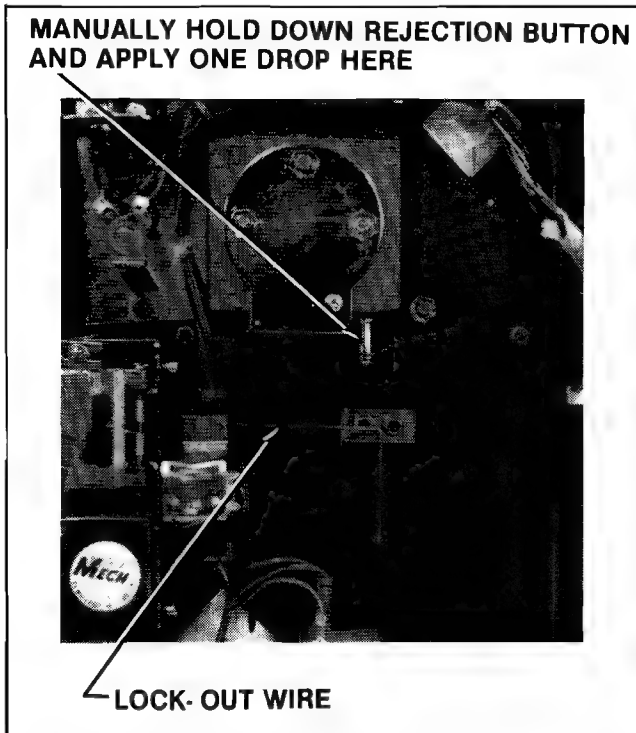
**Figure 3-5 Removal of Plate Covering Rear of Coin Slot**

## Lubrication

Do not apply lubrication to the coin mechanisms. The only points that may need lubrication (and only rarely) are the shafts of the scavenger buttons (coin rejection buttons) where they pass through the coin door. Apply only one drop of light machine oil, and be positive that no oil drops down onto a coin mechanism. Figure 3-6 shows this lubrication point.

## Adjustment of Coin Switch Trip Wire

In order for a coin switch to operate reliably when a coin travels down the secondary coin chute, the rest position of its trip wire should be as shown in Figure 3-7. Use extreme care when handling or touching these wires.



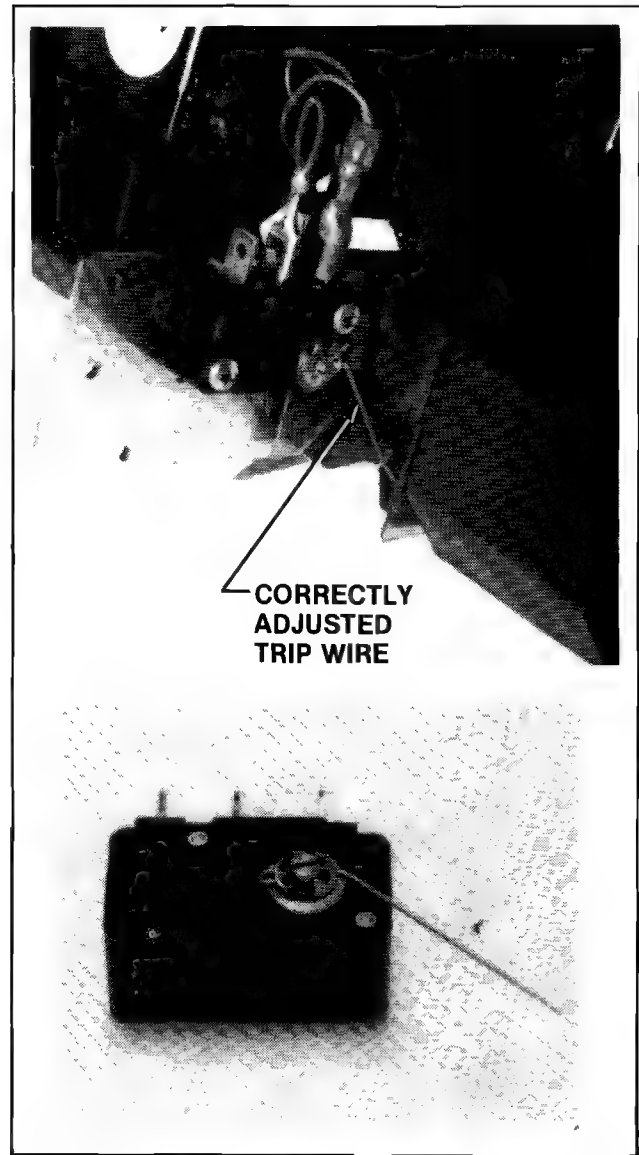
**Figure 3-6 Close-Up View of Lubrication Point**

In Figure 3-7 you will note that the coin switch trip wire is oriented into the "V" of the secondary coin chute. The wire should extend to only about 1/8" beyond the chute.

A retaining clip holds the wire onto the switch actuating stud. If you should loose a retaining clip, all is not lost. Just crimp the switch actuating stud over the trip wire with a pair of pliers.

### **Mechanical Adjustments on Coin Mechanism**

Coin mechanisms are adjusted prior to shipment from the factory and normally will retain these adjustments for many months. If, due to wear or other causes, it becomes necessary to make new adjustments, remove the coin mechanism from the coin door. Then take it to a clean well-lighted area where it can be placed in a vertical position on a level surface (such as a bench top). Besides a screwdriver, you will need a set of several coins, including both new and old, worn ones. Figure 3-8 shows an exploded view of the mechanism and gives procedures for adjusting the kicker, separator, and the magnet gate. These adjustments should only be done by someone who has experienced in servicing coin mechanisms and who understands their operation.



**Figure 3-7 Detail View of Coin Switch and Trip Wire**

### **General Troubleshooting Hints**

The first action is to look for jammed coins. After these have been removed, examine the coin path for presence of foreign material or loose objects (such as chewing gum, small metallic objects, paper wads, etc.). In cases where game usage is heavy, it may be necessary to clean the entire coin path periodically, in order to prevent build-up of contaminants that can hinder the movement of coins through the mechanisms. Also confirm that the trip wire on each coin switch is intact, and is properly adjusted. If troubles still persist, check the conditions and positions of the lock-out wires, and the mechanical adjustments on the coin mechanisms, before suspecting the electronics. If a coin mechanism



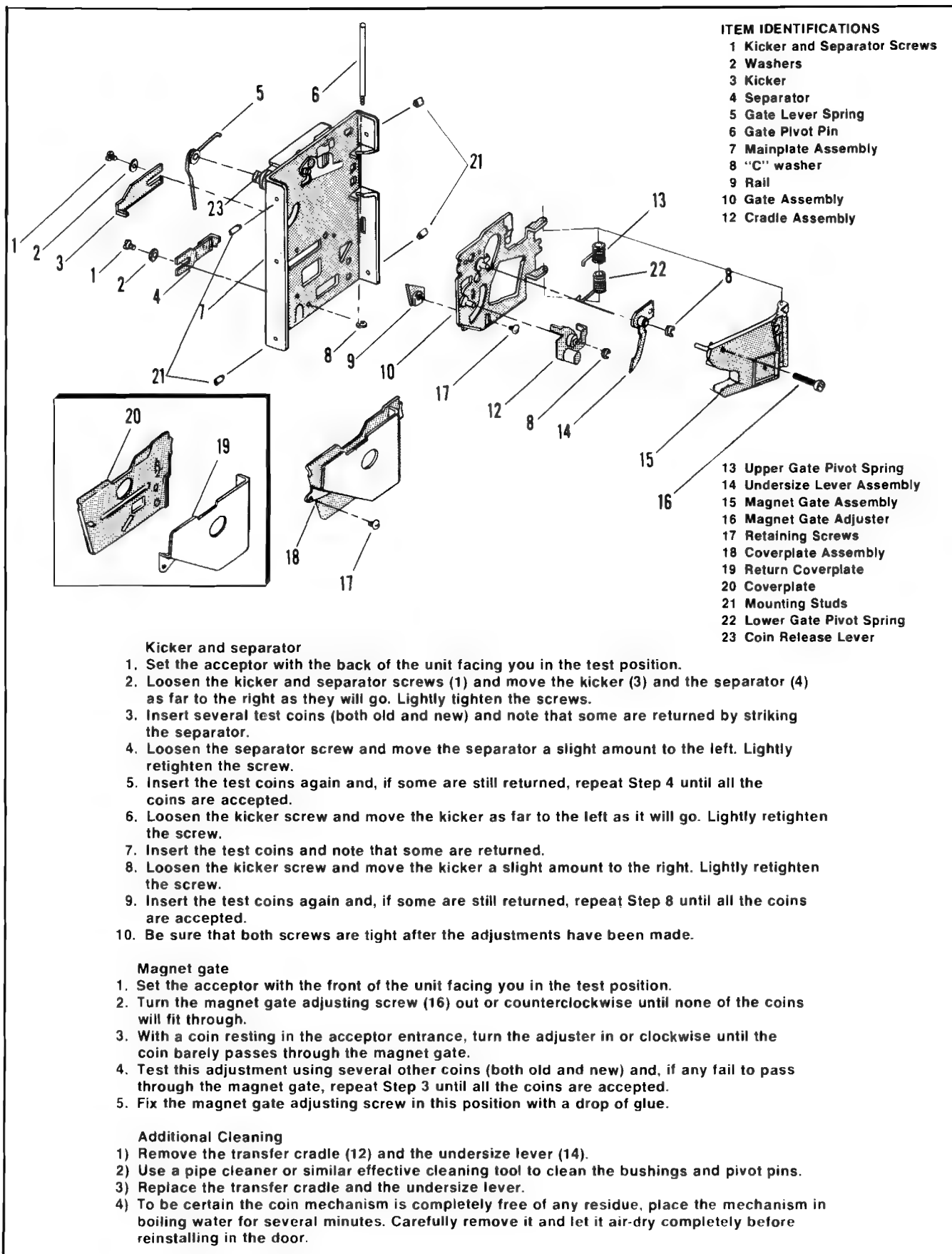


Figure 3-8 Coin Mechanism, Exploded View

rejects genuine coins, try to readjust it. If this is not successful, then replace it with a working mechanism.

Correct operation of the slam switch can be verified by putting the game into the test mode and performing the switch test (described in Table 1). Correct operation of the other switches and of the lock-out coil can also be checked by the switch test, or else merely by manually operating them and watching game responses as it changes from the attract mode to play mode, and then back to attract mode again.

### C. FUSE REPLACEMENT

Smokey Joe contains seven fuses, five on the power supply assembly in the lower part of the cabinet and two on the TV monitor assembly. Power supply fuses are accessible through the lower rear door assembly. TV fuses are accessible through the upper service panel door. Replace fuses only with the same type as follows:

#### TEC TM-600/623 Monitors:

3AG 2-amp and 0.5-amp quick-blow, 250 volts

#### Motorola M5000/M7000 Monitors:

3AG 0.8-amp quick-blow, 250 volts

#### Power Supply:

Fuses F1 and F2—3AG 3-amp slow-blow, 250 volts

Fuses F3 and F4—3AG 2.5-amp slow-blow, 125 volts

Fuse F5—3AG 8-amp fast-blow, 125 volts

### D. TV MONITOR ADJUSTMENTS

#### CAUTION

For best results be sure the game has been turned on for a while before making any TV monitor adjustments.

#### NOTE

The TV monitor adjustments are accessible through the rear door panel of the game cabinet. These adjustments have to be done while the game is energized. Therefore, only persons familiar with safety measures and repair procedures on electrical equipment should perform them.

The TV monitor should be adjusted only when the picture is distorted or if the contrast or brightness seem out of adjustment.

The monitor's adjustments function like those of a conventional, home television set, except that the volume adjustment has no effect. Instead, the game produces its sound in circuits separate from the TV monitor. Figure 3-9 shows the location of the adjustments on both TV monitors used by Atari. Your game contains a TV monitor manufactured to Atari specifications by either Motorola or TEC.

When making adjustments, follow these general guidelines:

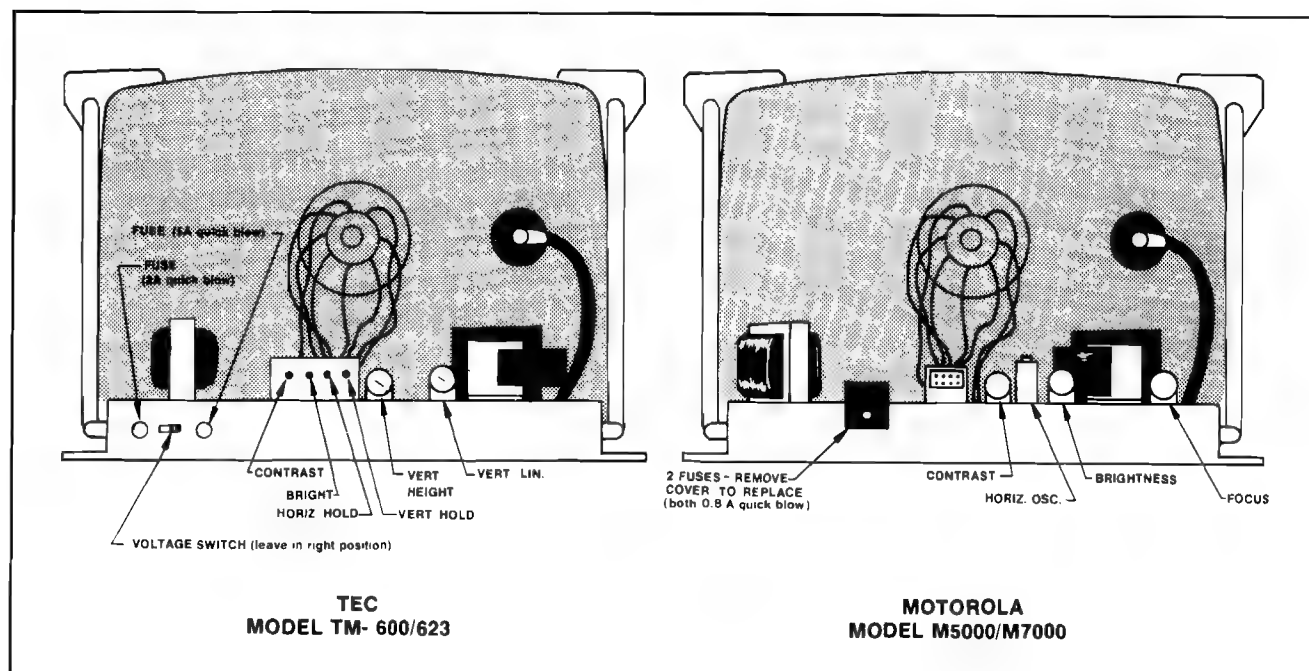


Figure 3-9 Locations of Adjustments on TV Chassis

**BRITE (Brightness)**—Perform this adjustment before the contrast. Adjust so that the white lines covering the screen just barely disappear, when the brightness is turned up.

**CONT (Contrast)**—Adjust so that the images are as bright as possible against the dark background without being blurred.

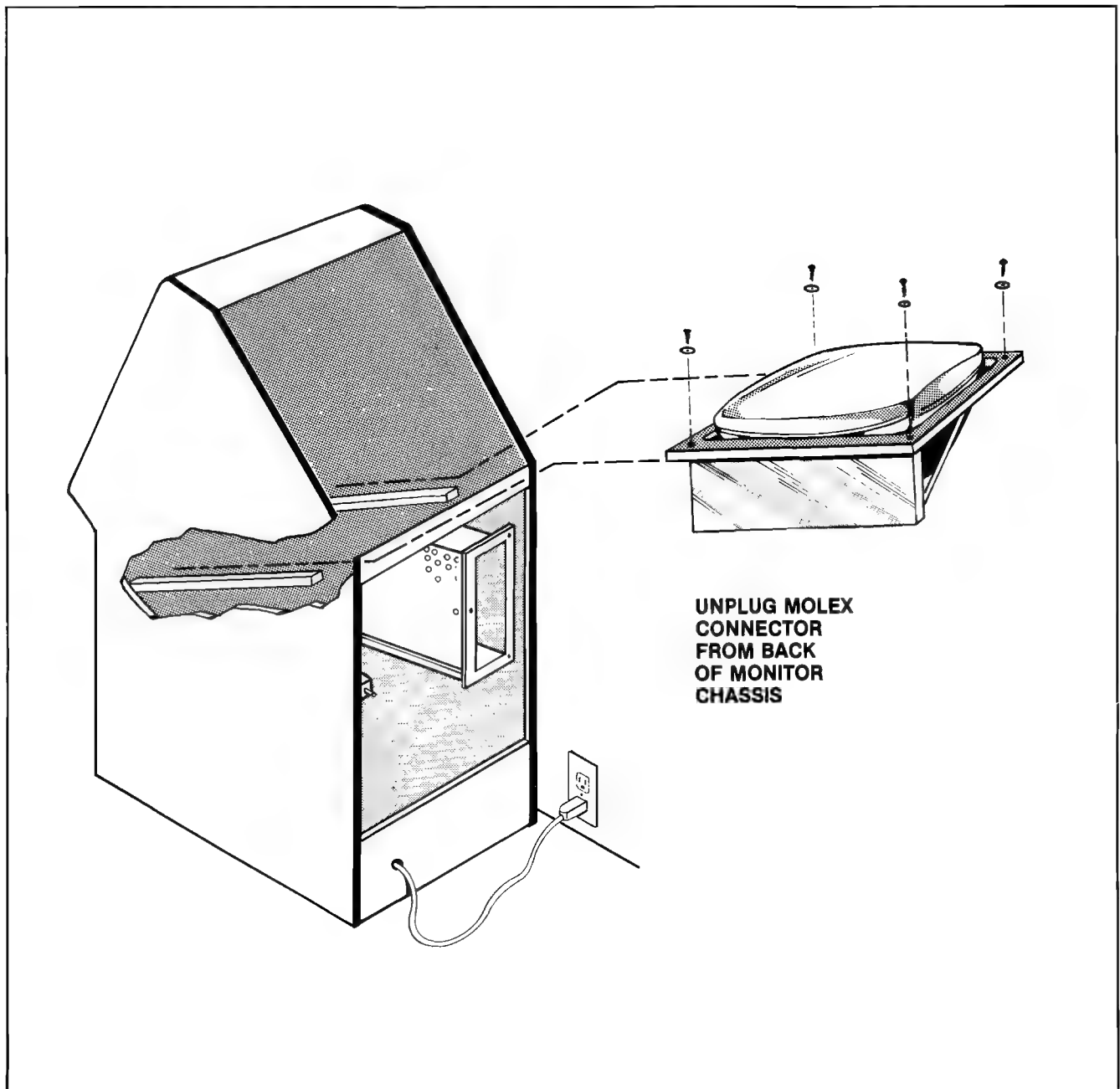
**HORIZ HOLD (Horizontal Hold) or HORIZ OSC (Horizontal Oscillator)**—Adjust if the picture is slightly off-center horizontally, if the images ap-

pear warped, or if the picture is broken up into a series of diagonal lines. Adjust for a stable, centered picture.

**VERT HOLD (Vertical Hold)**—This needs adjustment only if the picture appears to be rolling up or down the screen. Adjust for a stable, centered picture.

### **E. TV MONITOR REMOVAL (See Figure 3-10)**

If the TV Monitor proves to be at fault, remove the monitor as shown in Figure 3-10



**Figure 3-10 TV Monitor Removal**

## F. LAMP REPLACEMENT (See Figure 3-11)

Smokey Joe contains an 18-inch fluorescent lamp inside the top of the game cabinet assembly. To replace the lamp, remove the Plexiglas® retainer and screen as shown in Figure 3-11.

## G. SWITCH (LED) AND BUTTON REPLACEMENT (See Figure 3-12)

The player Start buttons and track select buttons on both control panels are LED (light-emitting diode) switches. The Horn and Bell buttons are actually start button assemblies.

*Unplug the power cord before working inside the game cabinet.*

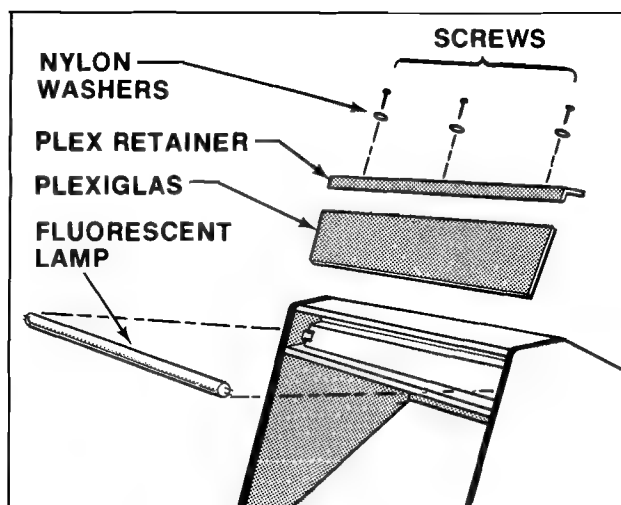


Figure 3-11 Fluorescent Lamp Removal

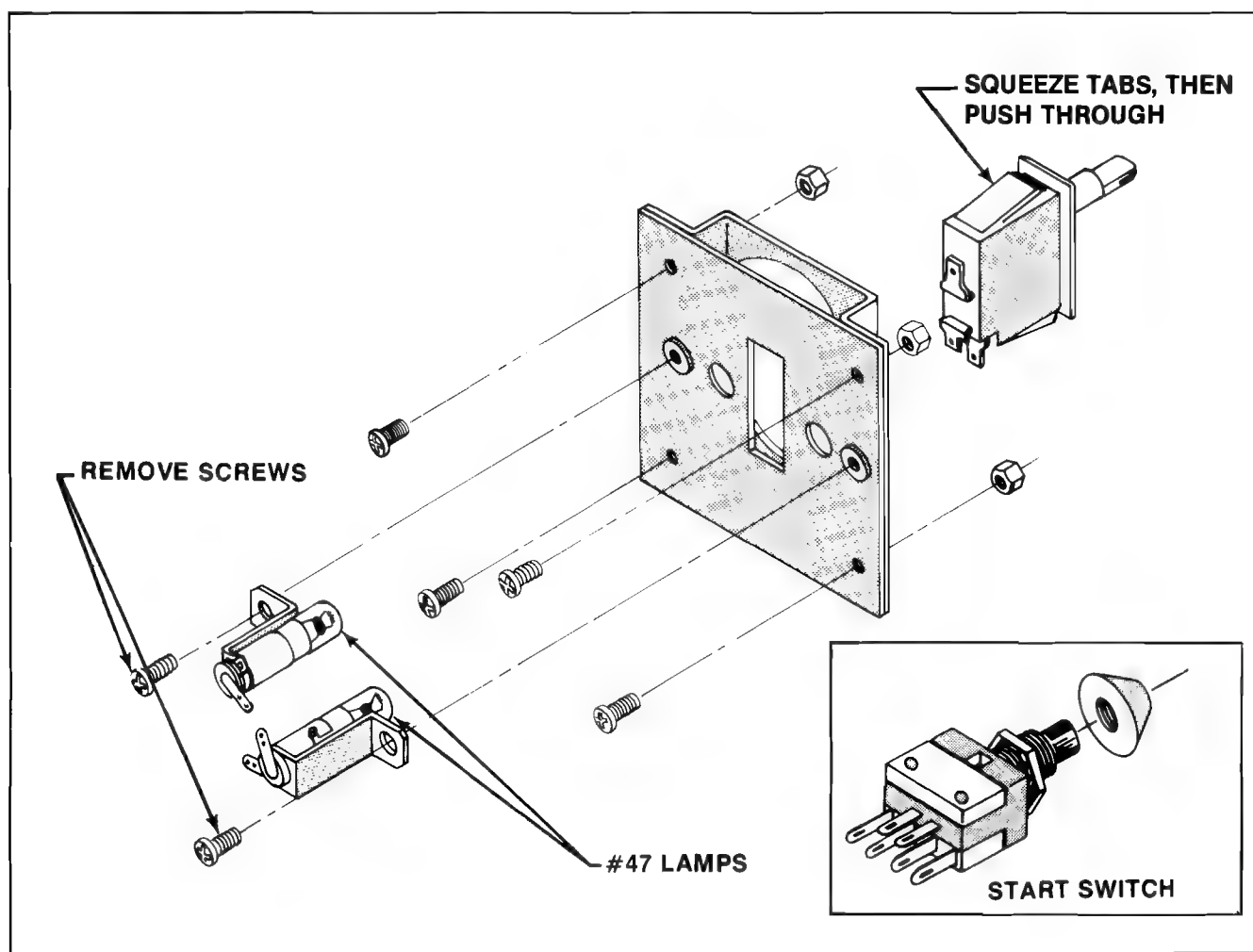


Figure 3-12 Switch and Button Replacement

To remove the switches and Horn button on the *front control panel* it is necessary first to remove the rear door assembly. Reach in through the back of the cabinet and remove two wing nuts securing the control panel assembly to the cabinet. It is possible at this point to partially remove the control panel. (The panel is hinged and can be moved outward in order to expose the underside.) The switches are now accessible for servicing.

To replace an LED switch:

- Remove all wires from the suspected switch.
- Turn the switch counterclockwise while holding the cone-shaped nut on the outside of the game cabinet.
- Install a new switch using the reverse procedure.
- Reconnect the harness wires.

To replace the Horn or Bell button:

- Remove all wires from the suspected switch.
- Remove four screws that secure the plates surrounding the button to the control panel.
- Squeeze both sides of the switch and pull out.
- Replace the switch using the reverse procedure (switch part number 62-020).

The LED switches and bell button on the *back or seat control panel* are accessible for servicing when the

panel is removed. Unlock and open the coin door. Reach in through the coin door and remove the two wing nuts as shown in Figure 3-12. Remove the control panel and follow the same procedures as described for replacing the switches and button on the front control panel.

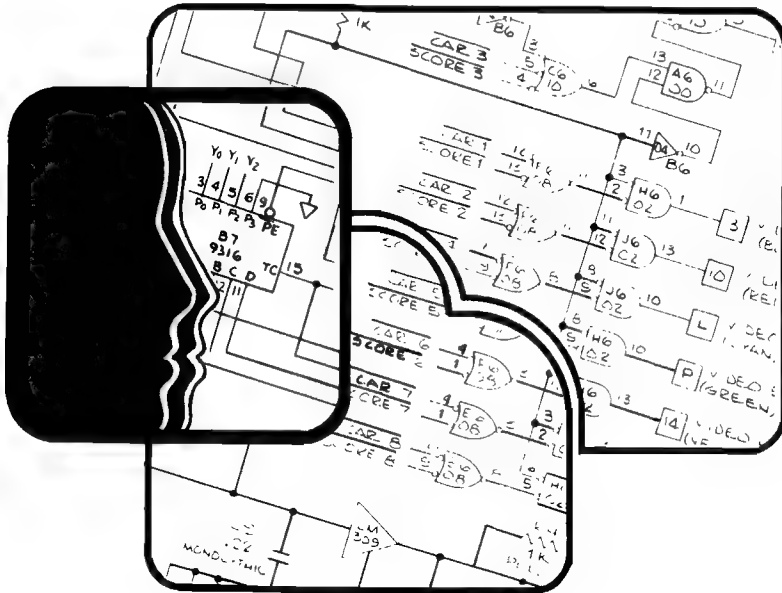
## **H. STEERING PCB REPLACEMENT**

If it becomes necessary to replace the steering PCB, use the following procedure:

1. Unlock and remove the rear access door to the game cabinet.
2. Unplug the 10-pin Molex connector from the steering board PCB.
3. With a 7/16-inch wrench, remove the self-locking hexagonal nut and ¼-inch internal tooth starlock washer from the steering wheel axle screw, while a helper holds the steering wheel at the front of the cabinet.
4. Remove the black plastic edge-toothed wheel.
5. Remove the steering PCB by removing two panhead #2-56 x ½-inch Phillips screws and lifting the board out.
6. Before installing the replacement steering PCB, be sure there is a sufficient amount of silicone lubricant on the inner hole of the black plastic edge-toothed wheel.
7. Install the replacement PCB by completing steps 1 through 5 in reverse order.







# THEORY OF OPERATION

## A. GENERAL INFORMATION

The PCB block diagram of Figure 4-1 illustrates the major circuit blocks and their related controls either on the board or remote. The input/output lines are also shown. Figure 4-2 is a general overview of the Smokey Joe game.

The game has a solid-state, self-contained television monitor which produces a picture quite unlike that of your home television screen.

The composite video signal from the game PCB is comprised of only four video levels instead of the more or less continuous shades of grey seen on a home television screen. The background of the picture is black video and the game objects are grey and/or white video levels.

On the game PCB schematic diagram of Figure 4-4, the symbol "P" (appearing at various inputs of integrated circuit devices) indicates a connection of +5 volts DC through a pull-up resistor.



Smokey Joe

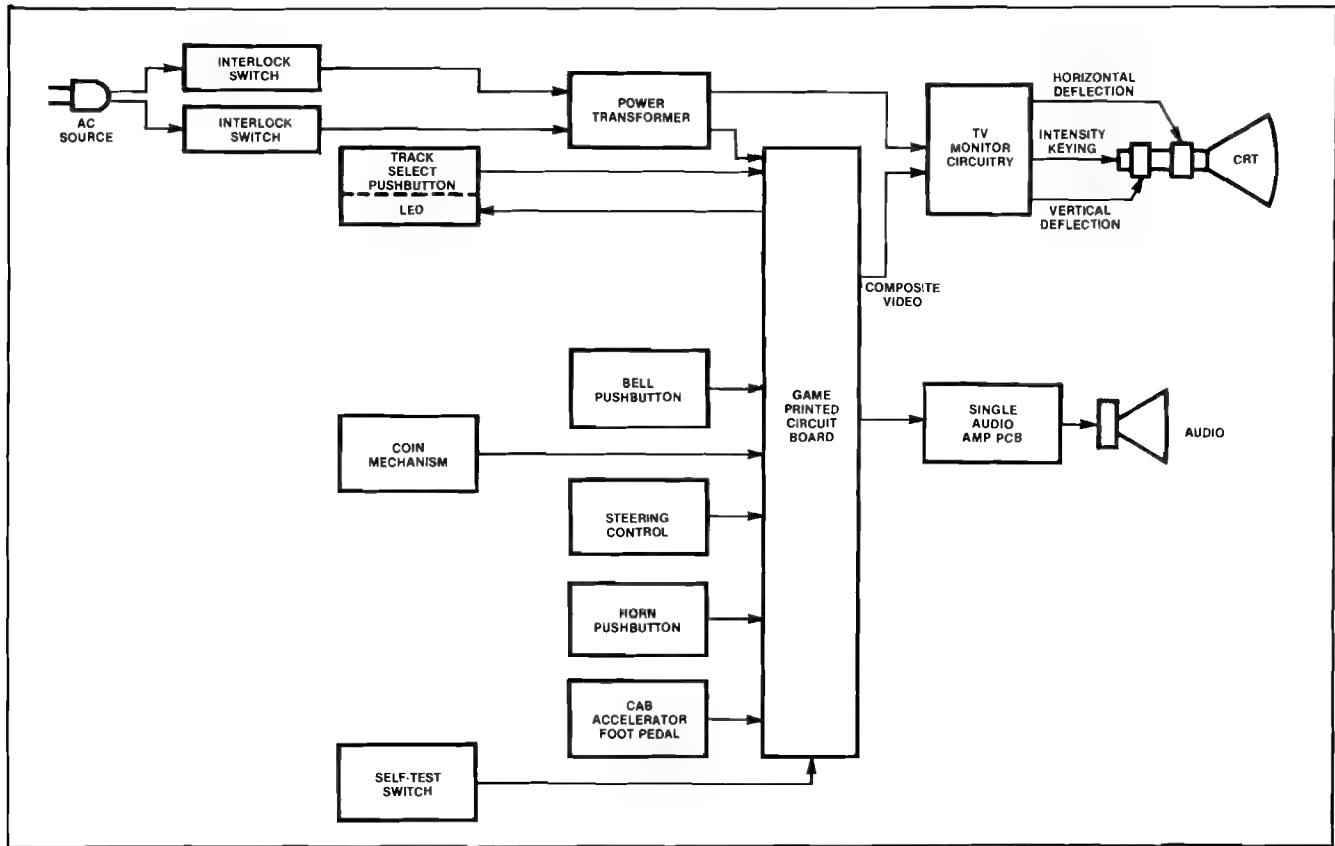


Figure 4-1 Functional Block Diagram of Smokey Joe Game

For easy location reference, the board is divided into sections. These sections are identified by letters A through R (skipping letters G, I, O, and Q because they may be easily confused with numbers 6, 1, and 0 respectively) across the short side of the PCB. Sections are identified along the long side of the PCB by numbers 1 through 11. The letters and numbers create a grid, and all ICs are located on the PCB along the grid lines.

An LM323 regulator is mounted in a large black heatsink and next to it is a 4-ohm, 10-watt resistor. These components produce a great deal of heat during normal operation. The temperature is not extreme, but sensitive skin may burn to the touch.

The harness schematic of Figure 4-7 illustrates how all the electrical and electronic assemblies electrically connect.

## B. POWER SUPPLY (See Figure 4-6, Sheet 1 of 6)

The PCB receives +10 volts unregulated from the type B power supply chassis. This raw +10 volts DC is then regulated by an LM323 three-terminal device to a stable +5 volts DC. The +5 volts DC is distributed throughout the board to power all of the Smokey Joe PCB logic. At the top of the PCB, most of the wide traces are DC ground. On the back of the board the wide trace along the long end of the PCB is 5 volts DC.

## C. CRYSTAL-CONTROLLED OSCILLATOR AND TV SYNC GENERATOR (See Figure 4-6, Sheet 1 of 6)

The crystal-controlled oscillator generates a 12-MHz clock frequency (specifically 12.096 MHz) that

**Figure 4-2 Block Diagram of the Smokey Joe PCB**

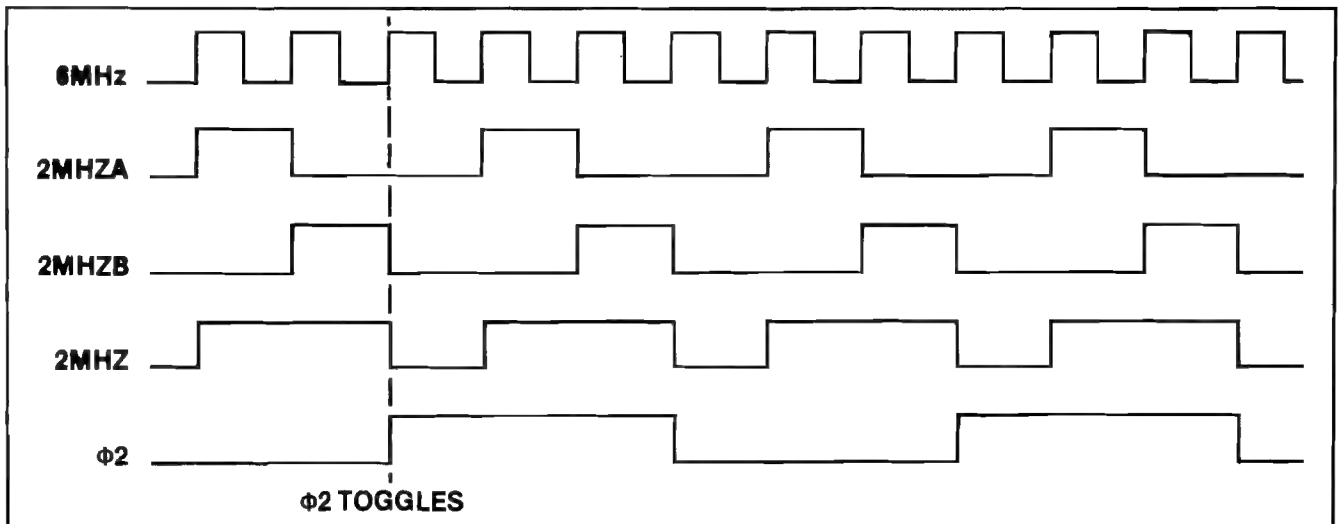


Figure 4-3a 1MHz Timing Chart (Normal Operation)

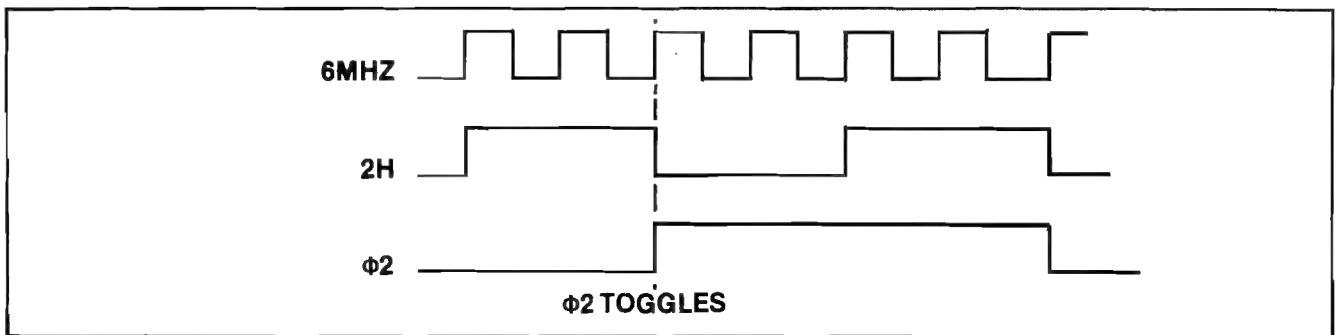


Figure 4-3b 750 KHz Timing Chart (Self-Test Only)

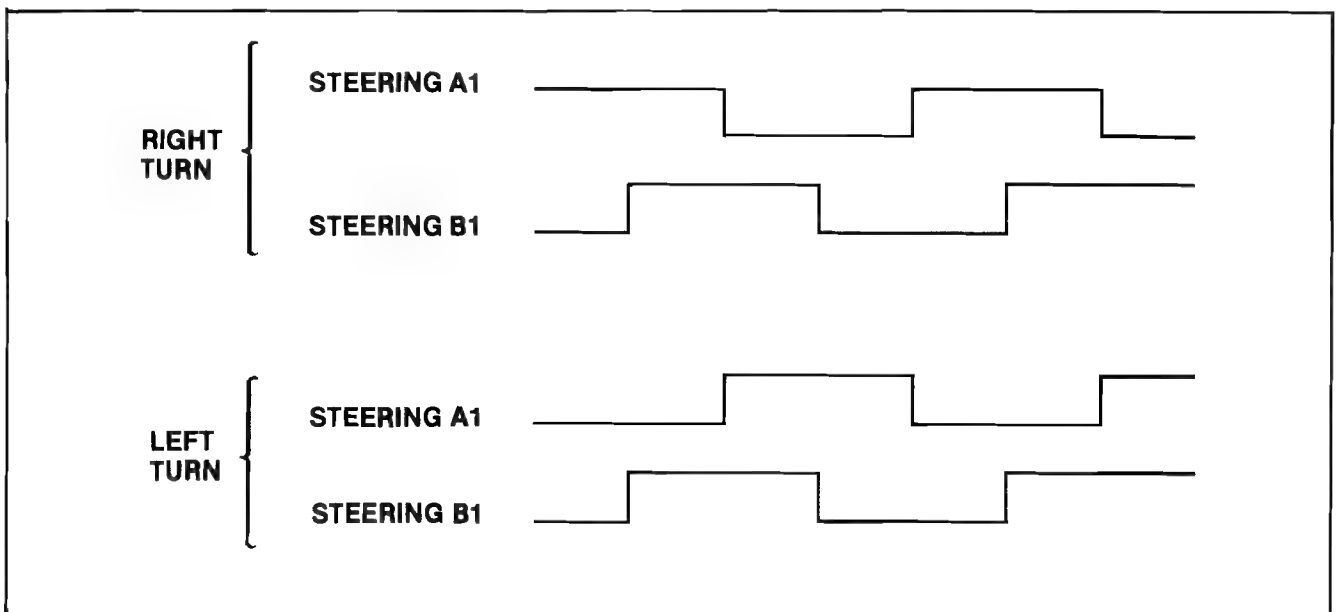


Figure 4-4 Steering Printed Circuit Assembly Output Pulses

is used to produce all of the operating frequencies required of the game PCB.

The oscillator output (12 MHz) is divided by the divide-by-two flip-flop to develop two 6-MHz signals (designated as 6 MHz and 6 MHz). The horizontal sync counters N9 and N10 are driven at 6 MHz, which provide the horizontal synchronizing pulses 1H through 256H. The signals HBLANK and HSYNC are developed in flip-flop P9. HSYNC is the clock input for the vertical counters which provide the vertical synchronizing pulses 1V through 128V. VBLANK and VSYNC are developed by a special coded ROM (read-only memory) at R4.

The horizontal and vertical synchronization signals are used to produce a TV monitor raster made up of 262 horizontal lines at a frequency of 15,750 Hz (256H). Synchronized with line 240 is a vertical blanking pulse that occurs for the duration of 22 more horizontal scans, resulting in the total number of 262 lines per frame. Each frame is repeated 60 times per second.

## **D. MICROCOMPUTER**

The microcomputer consists of read-only memory (ROM), random-access memory (RAM), and a microprocessor. The microprocessor controls the microcomputer operations through a 16-bit address bus which addresses the program ROMs. Address lines BA0 through BA7 are also multiplexed with data signals to address the playfield and alphanumeric RAM. An 8-bit bi-directional data bus provides a path for transferring data between the microprocessor and the various memories. A special watchdog circuit makes certain that the microcomputer functions properly.

Address lines (BA0-BA10) are buffered to eliminate signal loading. These buffered address lines address the program ROMs (J1, J2, K1, K2, L1, L2, M1 and M2 for the -01 version and C1, D1, F1 and H1 for the -02 version). The direct non-buffered address lines from the microprocessor are A11-A15.

## **E. MICROPROCESSOR (See Figure 4-6, Sheet 2 of 6)**

The 6800 microprocessor (C3) is a bi-directional bus-oriented 8-bit parallel chip with 16 bits of address to select 65K bytes of memory.

To better understand the microprocessor (MPU), refer to Table 4-1 for a complete description of the data, address and control lines to the MPU. Only those control lines used are discussed.

## **F. MICROPROCESSOR CLOCK (See Figure 4-6, Sheet 1 of 6)**

The microprocessor clocks ( $\Phi 1$ ,  $\Phi 2$ ) in this system run at 1 Mhz during normal operation and at 750Khz during a self-test sequence. Either of the two frequencies are enabled when the TEST signal changes logic state at pin 1 of Data Selector F7.

When the TEST signal is high, the trailing edge of the 2MHz B signal generated by flip-flop J8 (on sheet 1 of 6) is selected to clock the JK flip-flop D5. The game is in the normal operation as illustrated in timing diagram Figure 4-3a.

When the TEST signal goes low, the game is in the self-test mode which requires a 750Khz clock. This clock is generated by selecting the 2H input to F7; this input clocks the D5 flip-flop—dividing it down to 750Khz as illustrated in timing diagram Figure 4-3b.

## **G. MICROPROCESSOR WATCHDOG (See Figure 4-6, Sheet 2 of 6)**

Watchdog is an external monitoring system that resets the program execution back to its initial sequence. This is accomplished by a watchdog statement, incorporated in program memory, that results in a WATCHDOG RESET pulse at the output of the address decoder.

The watchdog circuit is a 5-bit shift register. In normal operation the circuit is pulsed once each TV picture frame by the VBLANK pulse. If five frames occur without a WATCHDOG RESET pulse, the counter resets the microprocessor. This prevents random electronic static from upsetting game operation. The power-on circuit or the hardware for reset presets the counter, which in turn initializes the microprocessor and starts the attract sequence.

## **H. ALPHANUMERIC GENERATOR (See Figure 4-6, Sheet 3 of 6)**

Alpha and numeric characters are displayed as 16 by 16 objects, comprised of 16 lines of 16 bits of video per line. These alphanumeric characters are stored in ROM R3 which is accessed by addressing data from RAMs N2 and P2. The microprocessor loads the alphanumeric location data into these RAMs. Specific times during the active video scan, as determined by the HRDWR signal at pin 8 of device L7, horizontal and vertical synchronization data address the alphanumeric location data stored in RAM. The RAM output data then addresses the actual video data stored in ROM R3.

**Table 4-1 Microprocessor Signal Descriptions**

| Signal           | Number of lines | Description/Function  |
|------------------|-----------------|---|
| D0-D7            | 8               | These eight lines are bi-directional data bus lines.  |
| A0-A15           | 16              | These sixteen lines are unilateral MPU address lines to supporting memory (i.e., ROMs, RAMs), and I/O.  |
| HALT             | 1               | This input is permanently connected to a 1K-ohm pull-up resistor.   |
| RESET            | 1               | This input line, when low, resets the MPU from either a power-down or on a QE output of the watchdog counter. During the reset sequence prior to RESET going high, the contents of the last two locations (FFFE, FFFF) in memory are loaded into the MPU program counter to point the start of a reset routine. |
| IRQ              | 1               | This input when low indicates an interrupt request to the MPU. After the MPU concludes its current sequence it will then proceed to the IRQ sequence.   |
| NMI              | 1               | This input line while going low indicates a non-maskable interrupt sequence. After the MPU concludes its current sequence it will then proceed to the NMI sequence.   |
| DBE              | 1               | This input line when high enables the MPU tri-state bus drivers. It is driven by the $\Phi 2$ clock.  |
| $\Phi 1, \Phi 2$ | 2               | Two-phase, non-overlapping MPU clock inputs.  |
| TSC              | 1               | This line is permanently tied to ground.  |
| R/W              | 1               | This output is the read and write signal line which indicates the direction of data transfers on MPU data bus.  |

The 4-bit parallel output of the ROM is then converted into serial data by shift register P4 and summed into the "Video Out" circuit as the "A/N Video" signal.

## **I. PLAYFIELD GENERATOR** (See Figure 4-6, Sheet 3 of 6)

The playfield generator is similar in operation to the alphanumeric generator. Playfield ROM F5 contains the actual playfield video data. ROM data access is controlled by RAMs J4 and H4. As in the alphanumeric generator, the playfield location data is stored in these RAMs by the microprocessor. Then at specified times during active video scan, as determined by the  $\overline{\text{PRAM}}$

signal at pin 2 of H2, the horizontal and vertical playfield position counters (E3, E4, F3 and F4) address the playfield location data stored in RAM. This data then addresses the playfield video ROM. The ROM's parallel output data is converted into serial data by shift register E8 and summed into "video out" as the PFLD signal.

## **J. CAB VIDEO GENERATOR** (See Figure 4-6, Sheet 4 of 6)

The cab video PROM (programmable read-only-memory) P7 contains the cab video display data. This PROM specifically contains four distinct cab video rotation displays (0 degrees through 45 degrees). All 24 rota-

tions required to rotate the cab a full 360 degrees are simulated by exchanging the horizontal and vertical sync signals, controlled by the state of the INVTVH strobe to data selectors P8 and R7, and/or by inverting the horizontal and vertical sync pulses via exclusive OR gates R6, R8 and N8. The video Prom's parallel output data is then converted to serial video data by data selector M7, and summed into the "Video Out" circuit as the "Cab Video" signal.

## **K. TAIL VIDEO GENERATOR (See Figure 4-6, Sheet 4 of 6)**

The tail video ROMs J5 and L5 contain the tail video display data. The ROMs actually contain data for seven distinct rotation pictures. Signals TR0, TR1 and TR2 select the proper rotation.

These seven rotations can simulate all 24 rotations necessary to rotate the tail a full 360 degrees. This simulation is accomplished by controlling the up/down polarity of up-down sync counters L3, K3, L4, and K4 (via XINV and YINV). The ROM parallel output data is then latched (at M5) and converted to serial video data by data selector N6, and summed into the "Video Out" circuit as the "TAIL VIDEO" signal.

## **L. STEERING CONTROL LOGIC (See Figure 4-6, Sheet 5 of 6)**

Steering (STEER 1A, 1B, 2A, 2B) information for both the cab and the tail is "looked" for by the microprocessor (C3) during the play mode. The steering PCB assembly consists of two light-emitting diodes that are optically aligned with two light-sensitive transistors. A toothed cylinder (turned by the steering wheel) is inserted between the light-emitting diodes and the transistors, and it interrupts the light from the diodes.

When the steering wheel is turned, two pulses appear at the output of the steering PCB assembly that differ in phase as illustrated in Figure 4-4. When the wheel is turned to the right, the A output pulse leads the B output pulse. When the wheel is turned to the left, the A output pulse lags the B output pulse. The inverse of the two pulses are applied to the D and clock inputs of the D-type flip-flops L10 and M11.

The MPU recognizes that a steering maneuver has been made when a low appears on data line BD7. The MPU then looks at the data line BD0 and determines from the logic level (high or low) whether the turn is left or right. Once the MPU has processed a steering maneuver, the MPU then outputs an address that is decoded by the address decoder and results in a low STEERING RESET signal. This signal resets the D-type flip-flop responsible for the STEER FLAG signal.

## **M. HORN AND BELL GENERATOR (See Figure 4-6, Sheet 6 of 6)**

The horn is manually sounded by pressing the large pushbutton labeled *HORN* at the cab control panel.

The bell is also manually sounded by pressing another large pushbutton labeled *BELL* at the tail (trailer) control panel. This also occurs automatically when points are scored. The bell is disabled by the microprocessor if the game is in the "front player only" mode (trailer is controlled by computer).

## **N. MOTOR AND SIREN GENERATOR (See Figure 4-6, Sheet 6 of 6)**

The key to the motor generator is the operation of transistor Q1 in conjunction with timer B9. Timer B9 operates as an oscillator with its output frequency dependent upon the collector voltage of Q1. This voltage is the result of the base voltage selected at the MOTOR 1, 2, 3, or 4 input lines.

As the Q1 base voltage increases, so does the charging voltage at the collector across capacitor C25. This VCO control voltage sets the VCO circuit at a frequency selected by the buffered data lines; the voltage is adjustable by setting pot R27. The VCO output is divided into two separate frequencies by the divide-by-twelve device A9, and is then summed by resistors R73 and R74. This produces a realistic motor sound as the player shifts gears.

The siren generator is similar to the motor generator. The control voltage to the VCO is generated by voltage levels present at resistors R45, R46, R47, R48 that drives voltage follower E9. The output of E9 is the control voltage that controls the output frequency of timer B9.

## **O. BANG AND SCREECH GENERATOR (See Figure 4-6, Sheet 6 of 6)**

The heart of the bang and screech generator is the noise generator comprised of 8-bit shift registers B8, C8. These two devices are connected in a manner to produce random noise at the QH (pin 13) output of B8.

The bang is the result of data (BD4-BD7) from the microcomputer; the data is used to gate varying amounts of random noise through to the audio amplifier. Starting with binary data code 1111, then rapidly stepping the data code down to 0000 results in gating noise from noise generator B8, C8 through a

resistive value of 550 ohms (R34, R35, R36, R37 in parallel) to 8.2K ohms for a data code of 0001, and infinity for a data code of 0000. The result is an envelope from full "on" to full "off".

The screech sound is produced by processing the output of the random noise generator with a type of hysteresis feedback loop, comprised of Schmidt-trigger inverter B4 (74LS14). This processed noise is gated to the audio summing network each time SKIDSND goes low and clears the B6 flip-flop.

## **P. AUDIO OUTPUT**

**(See Figure 4-6, Sheet 6 of 6)**

All the processed sounds (i.e. siren, motor, horn) are summed at the inverting input of op-amp E9. The output of E9 is then sent off the main PCB to be amplified by the "Single Audio Amplifier PCB."

## **Q. SINGLE AUDIO AMPLIFIER**

**(See Figure 4-9)**

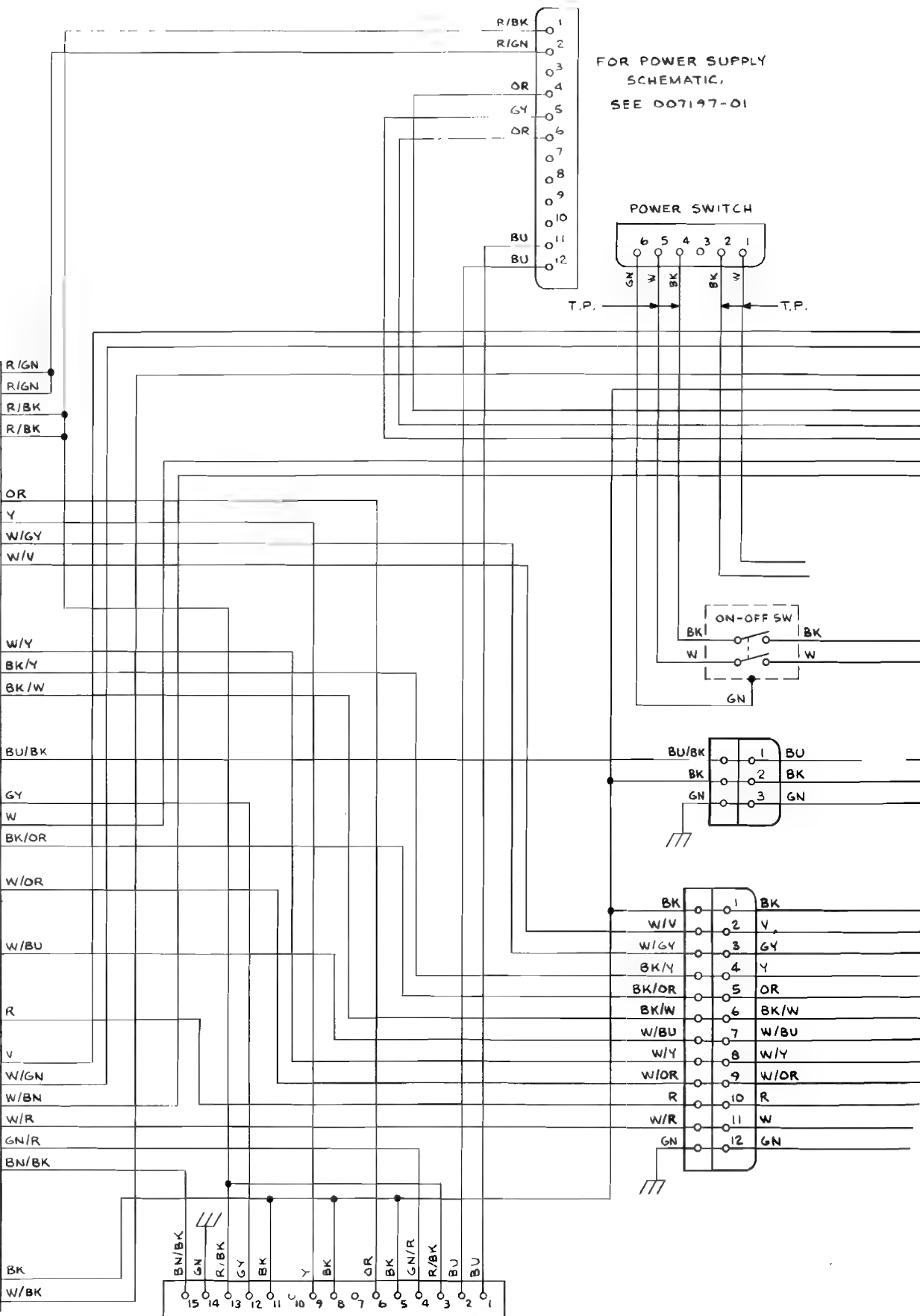
The single audio amplifier for Smokey Joe is the -01 version assembly which uses only one of the audio amplifier circuits. The audio output (pin 18 of the Smokey Joe PCB) from op-amp E9 is amplified and matched to an 8-ohm speaker. The audio level (volume) is adjustable by rotating the R2 potentiometer located on the Single Audio Amplifier PCB.



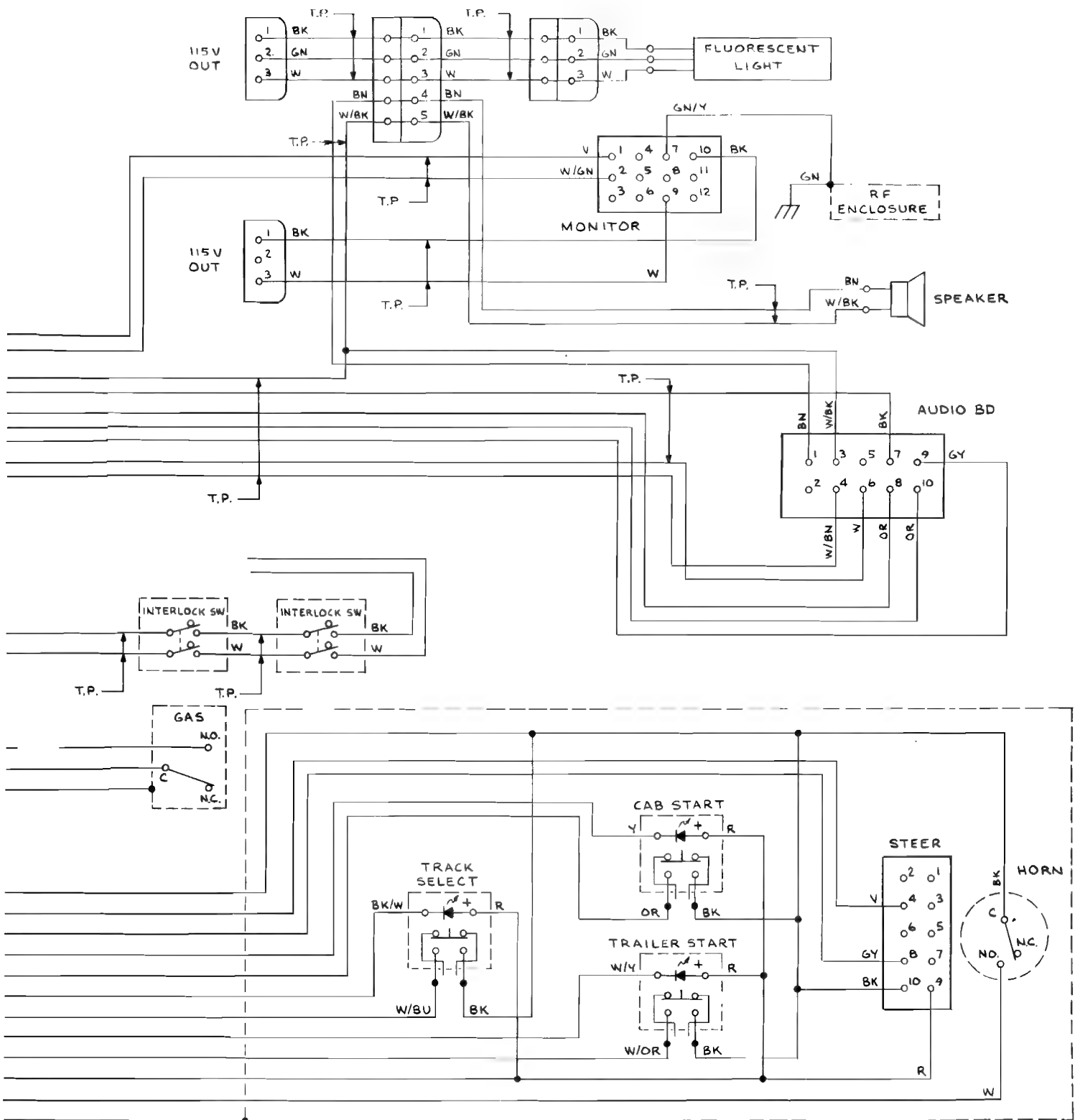


# 44-POS EDGE CONNECTOR

|                |    |       |
|----------------|----|-------|
| 16.5V CT GRD   | 1  | R/GN  |
| 16.5V CT GRD   | A  | R/GN  |
| +10V UNREG     | 2  | R/BK  |
| +10V UNREG     | B  | R/BK  |
|                | 3  |       |
|                | C  |       |
| COIN 1 N.O.    | 4  | OR    |
| COIN 2 N.O.    | D  | Y     |
| STEER 1A       | 5  | W/GY  |
| STEER 1B       | E  | W/V   |
|                | 6  |       |
|                | F  |       |
|                | 7  |       |
| START LAMP 3   | H  | W/Y   |
| START LAMP 1   | 8  | BK/Y  |
| TRACK SEL LAMP | J  | BK/W  |
|                | 9  |       |
|                | K  |       |
| GAS NO.        | 10 | BU/BK |
|                | L  |       |
| SLAM NO.       | 11 | GY    |
| TEST           | M  | W     |
| START 1 N.O.   | 12 | BK/OR |
|                | N  |       |
| START 3 N.O.   | 13 | W/OR  |
|                | P  |       |
|                | 14 |       |
| TRACK SEL NO.  | R  | W/BU  |
|                | 15 |       |
|                | S  |       |
| +5V            | 16 | R     |
|                | T  |       |
| VIDEO OUT      | 17 | V     |
| VIDEO GRD      | U  | W/GN  |
| AUDIO OUT      | 18 | W/BN  |
| HORN N.O.      | V  | W/R   |
| COIN CNTR      | 19 | GN/R  |
| LOCKOUT COIL   | W  | BN/BK |
|                | 20 |       |
|                | X  |       |
|                | 21 |       |
|                | Y  |       |
| GRD (SW.COM)   | 22 | BK    |
| AUDIO GRD      | Z  | W/BK  |

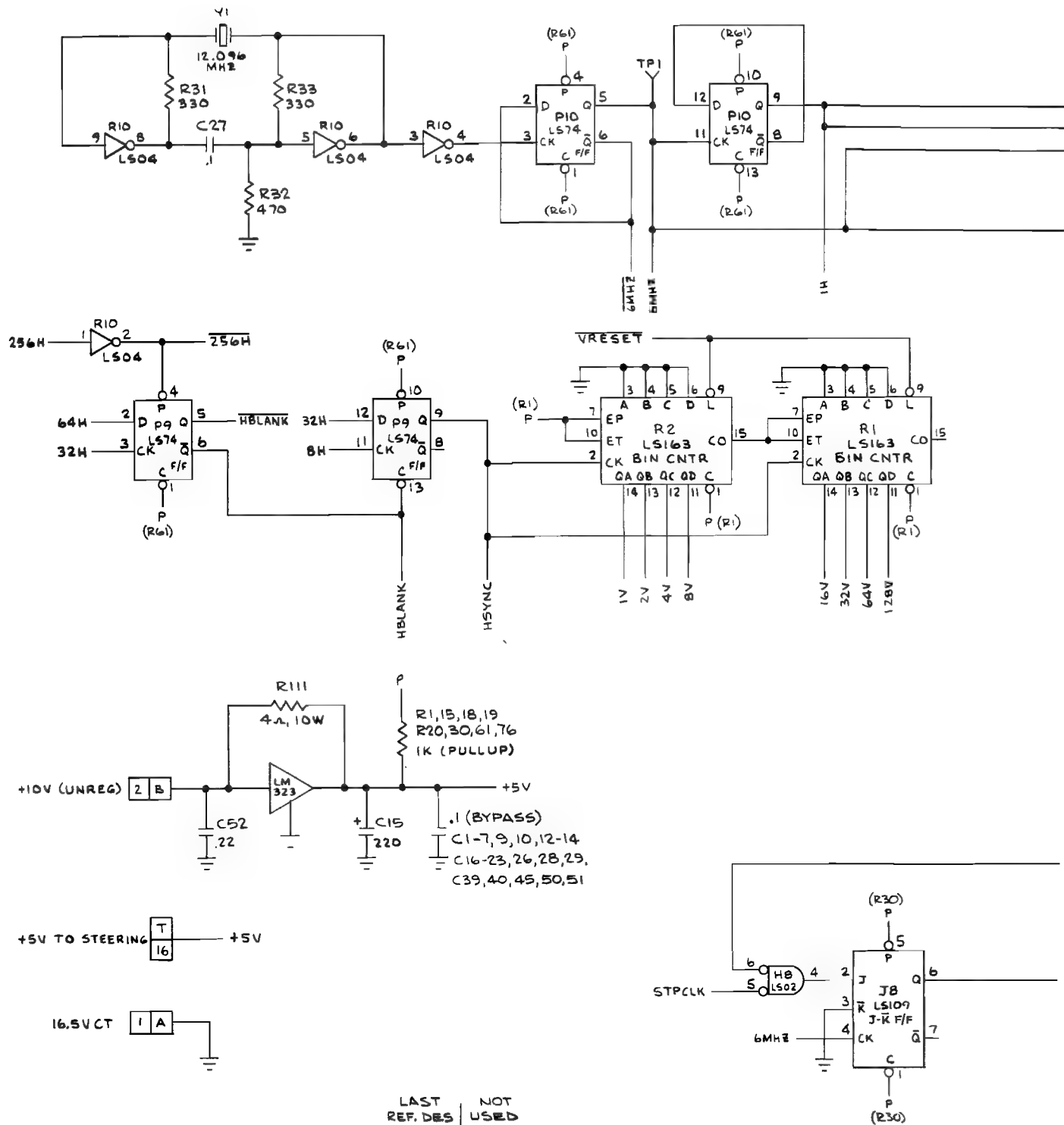


FOR COIN DOOR SCHEMATIC, SEE 030401-01

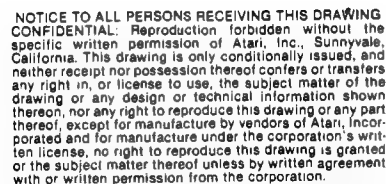


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Figure 4-5 Smokey Joe Harness Schematic Diagram

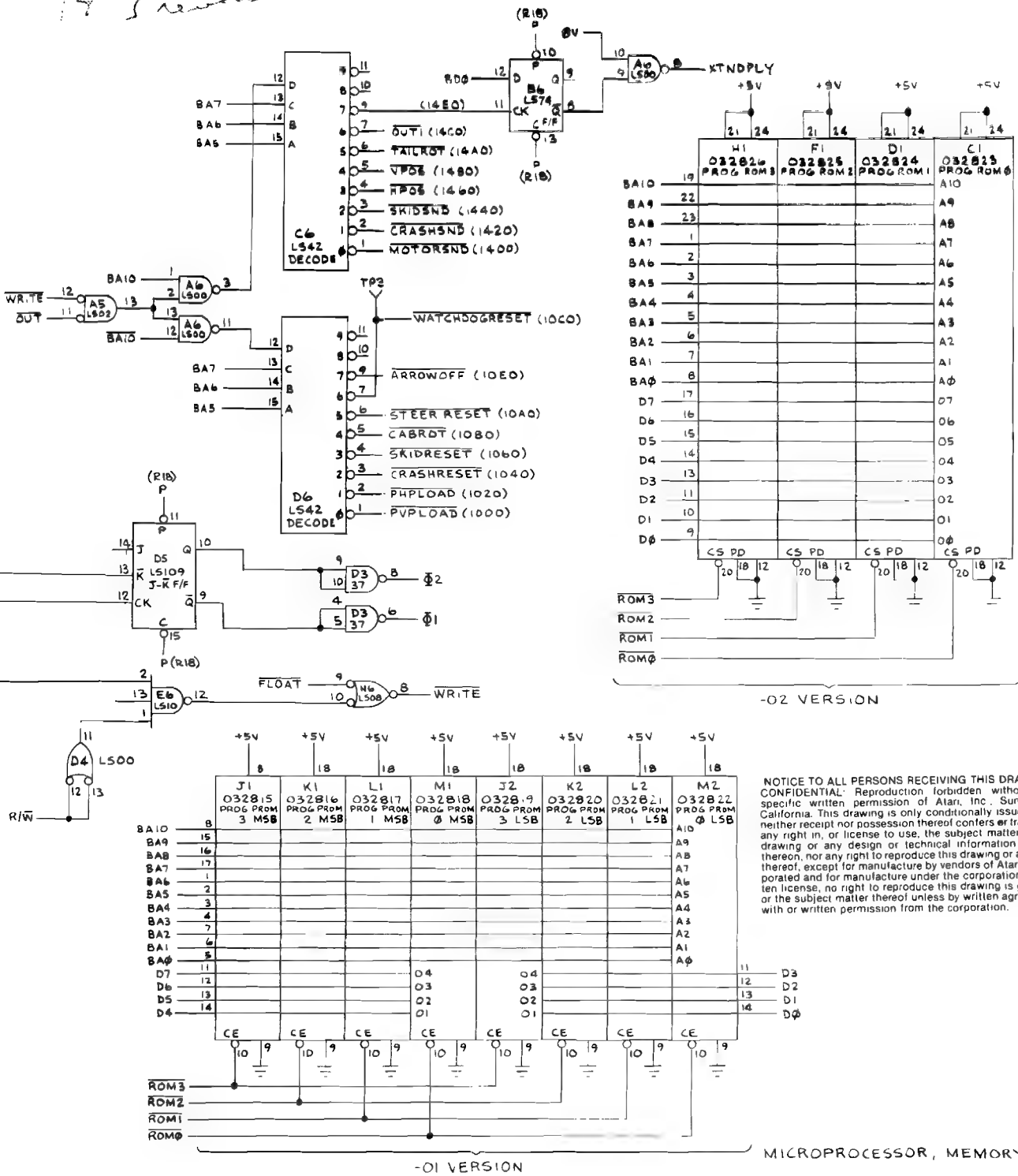


| LAST<br>REF. DES | NOT<br>USED |
|------------------|-------------|
| R112             |             |
| C53              | C38         |
| CR5              |             |
| Q6               |             |
| SW3              |             |
| TP6              |             |
| Y1               |             |

**Smokey Joe 4-13**

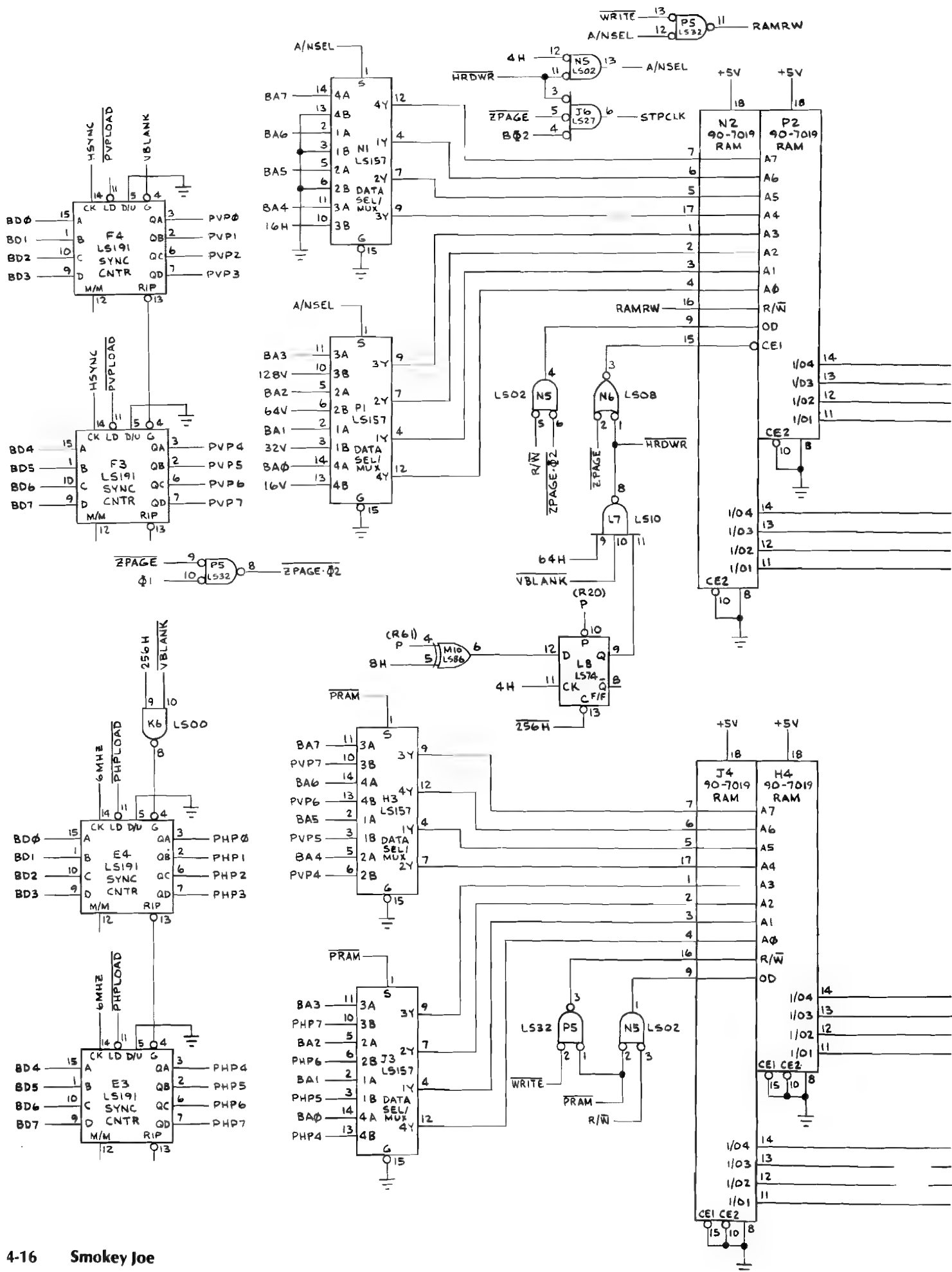


17 } revised



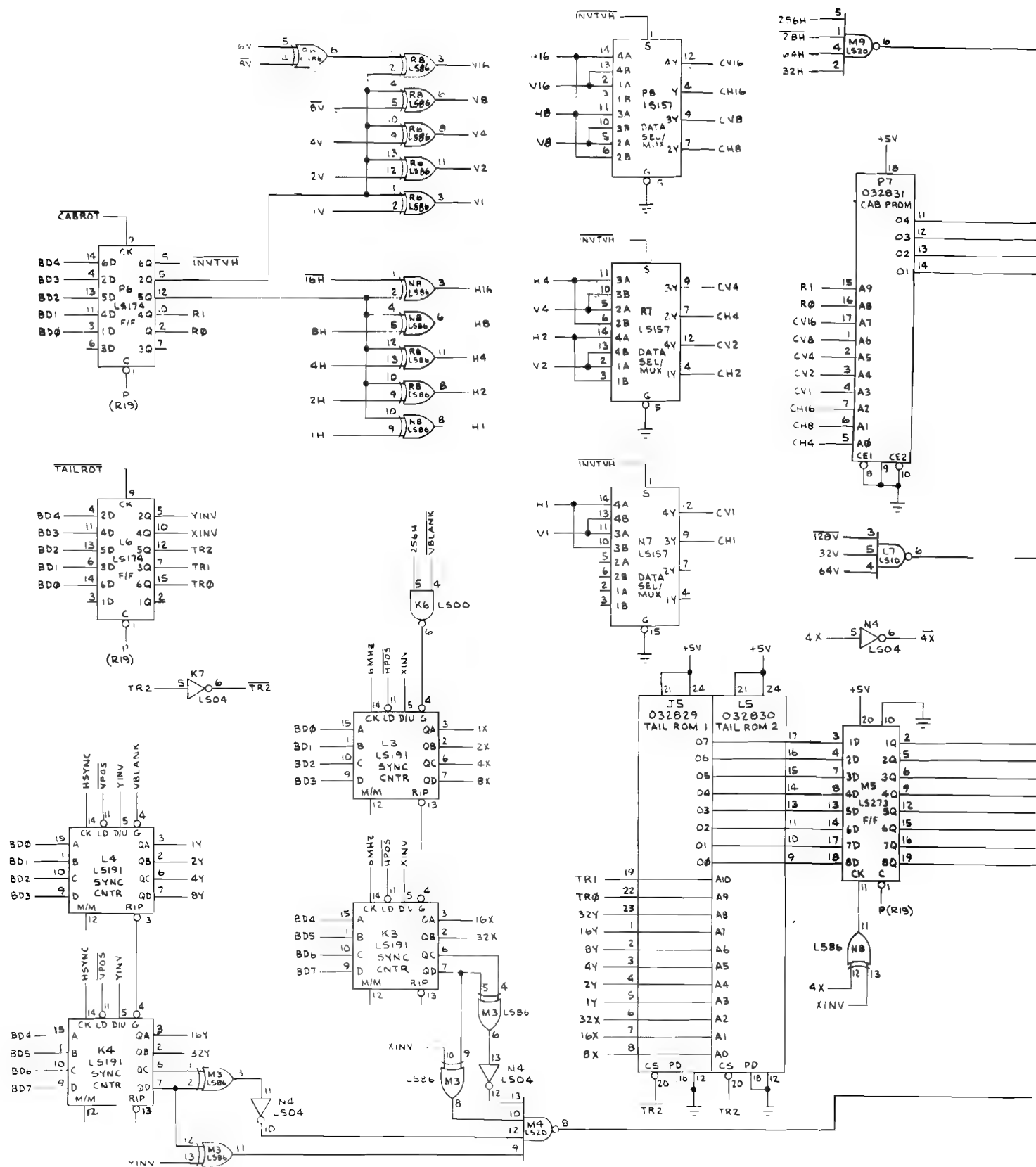
\*USE PIN NUMBERS IN PARENTHESES IF BOARD CONTAINS AMB304B INSTEAD OF 74LS245.

Figure 46 Smokey Joe PCB Schematic Diagram Sheet 2 of 6





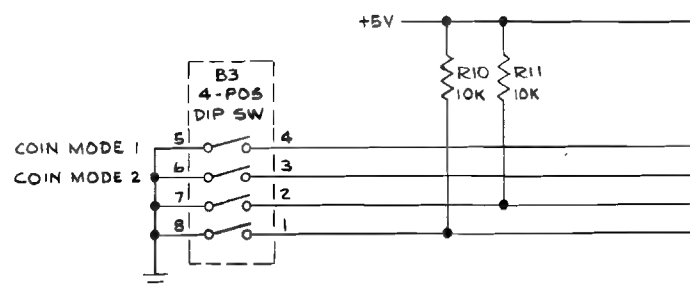
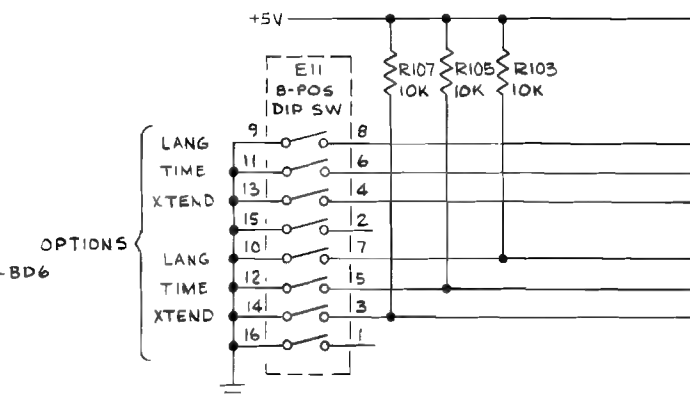
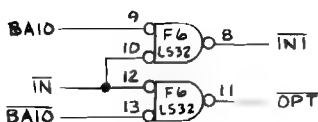
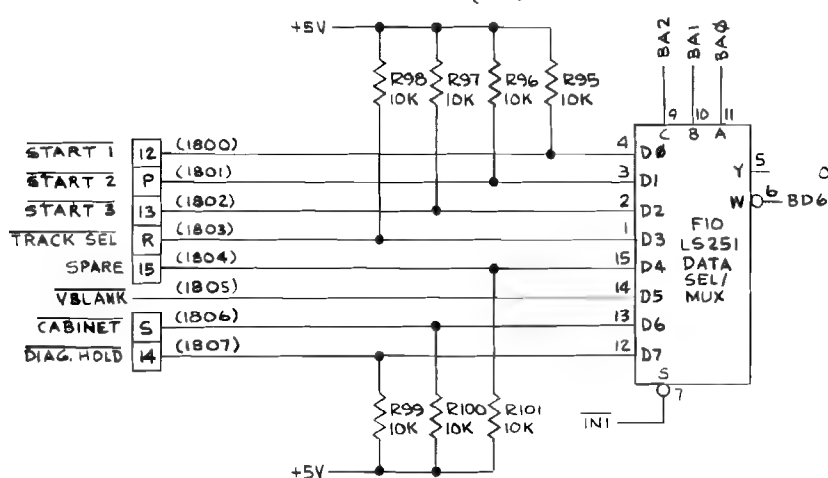
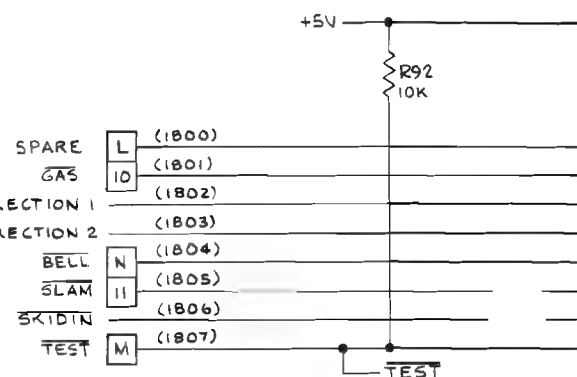
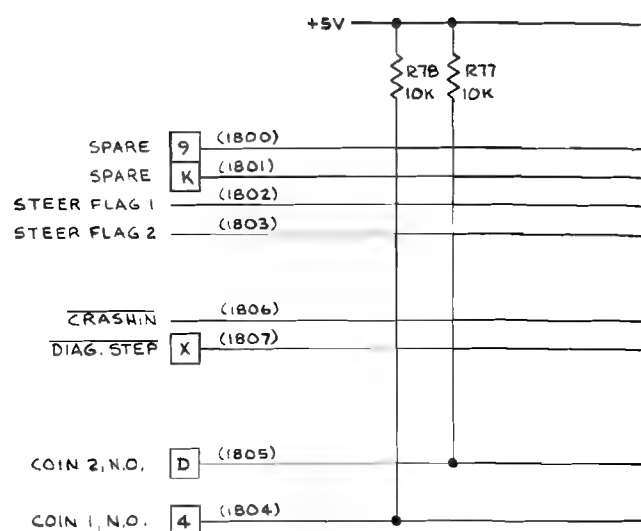
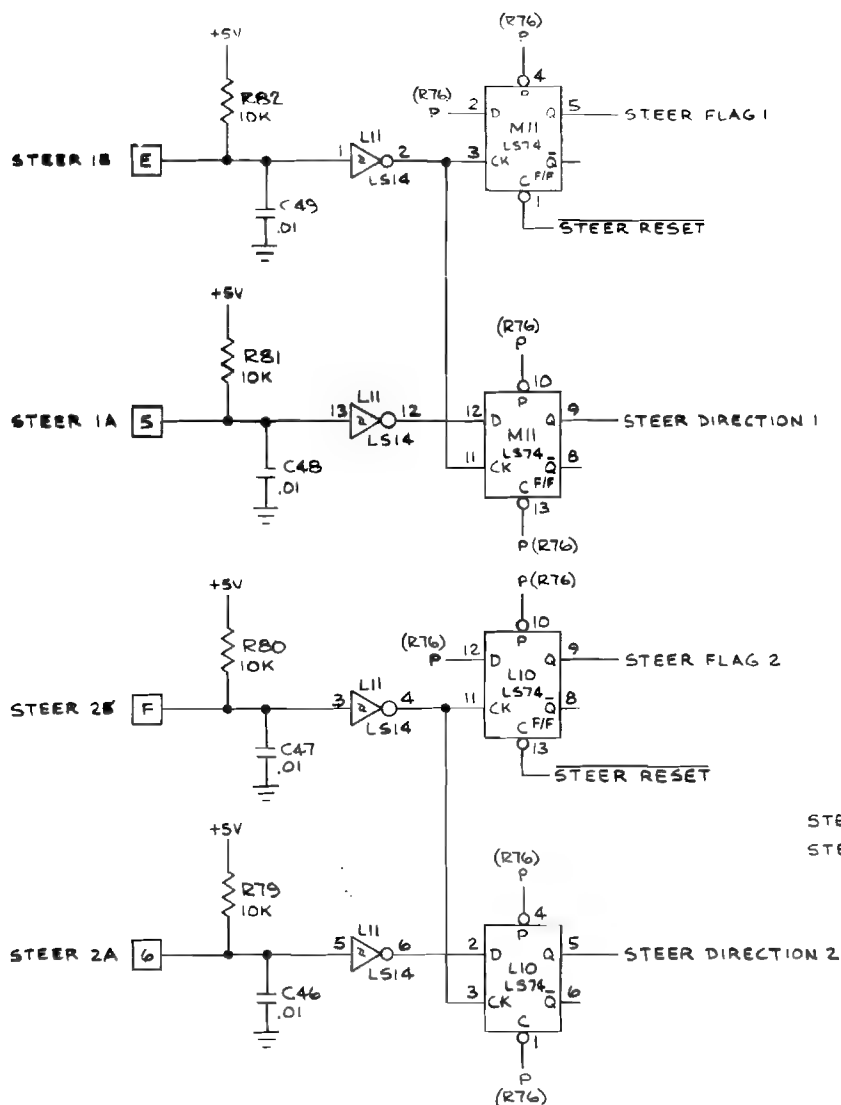




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**Figure 4-6 Smokey Joe PCB Schematic Diagram**

**Smokey Joe 4-19**







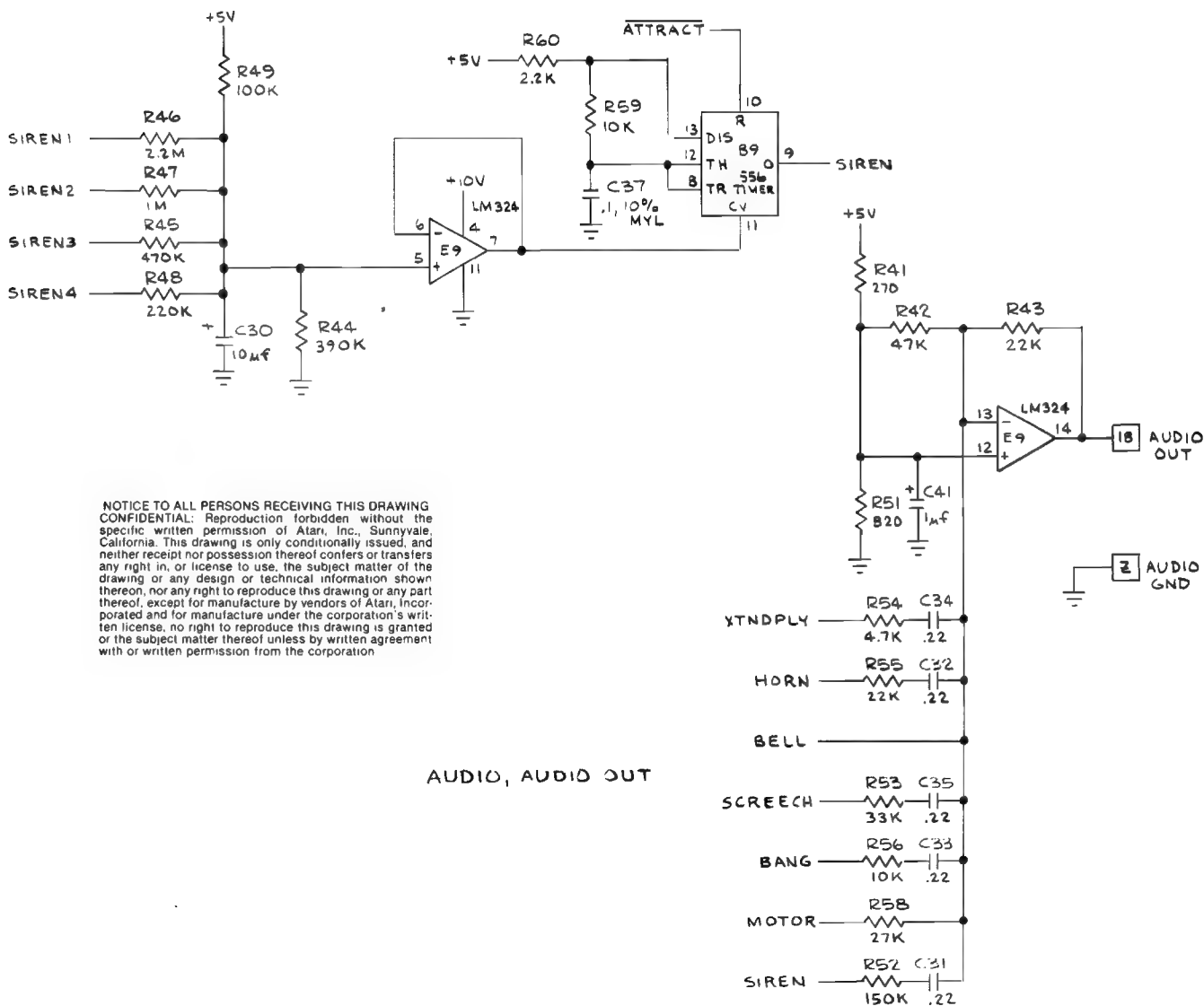
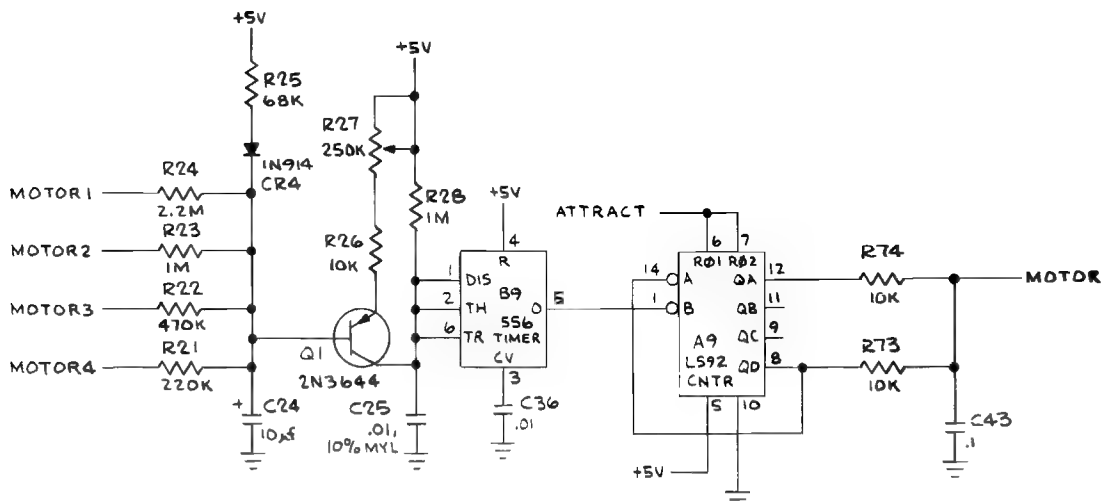


Figure 4-6 Smokey Joe PCB Schematic Diagram  
Sheet 6 of 6

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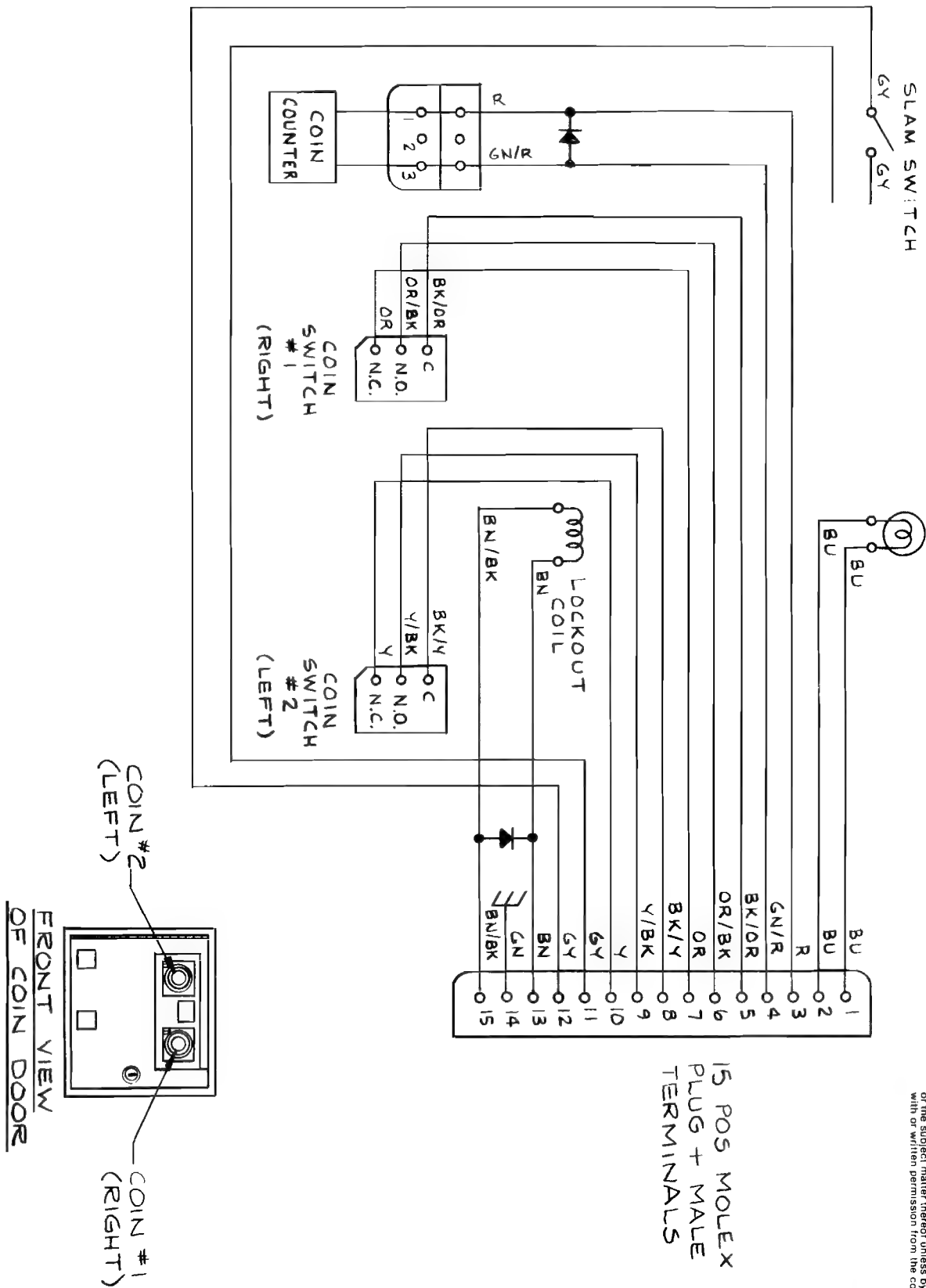
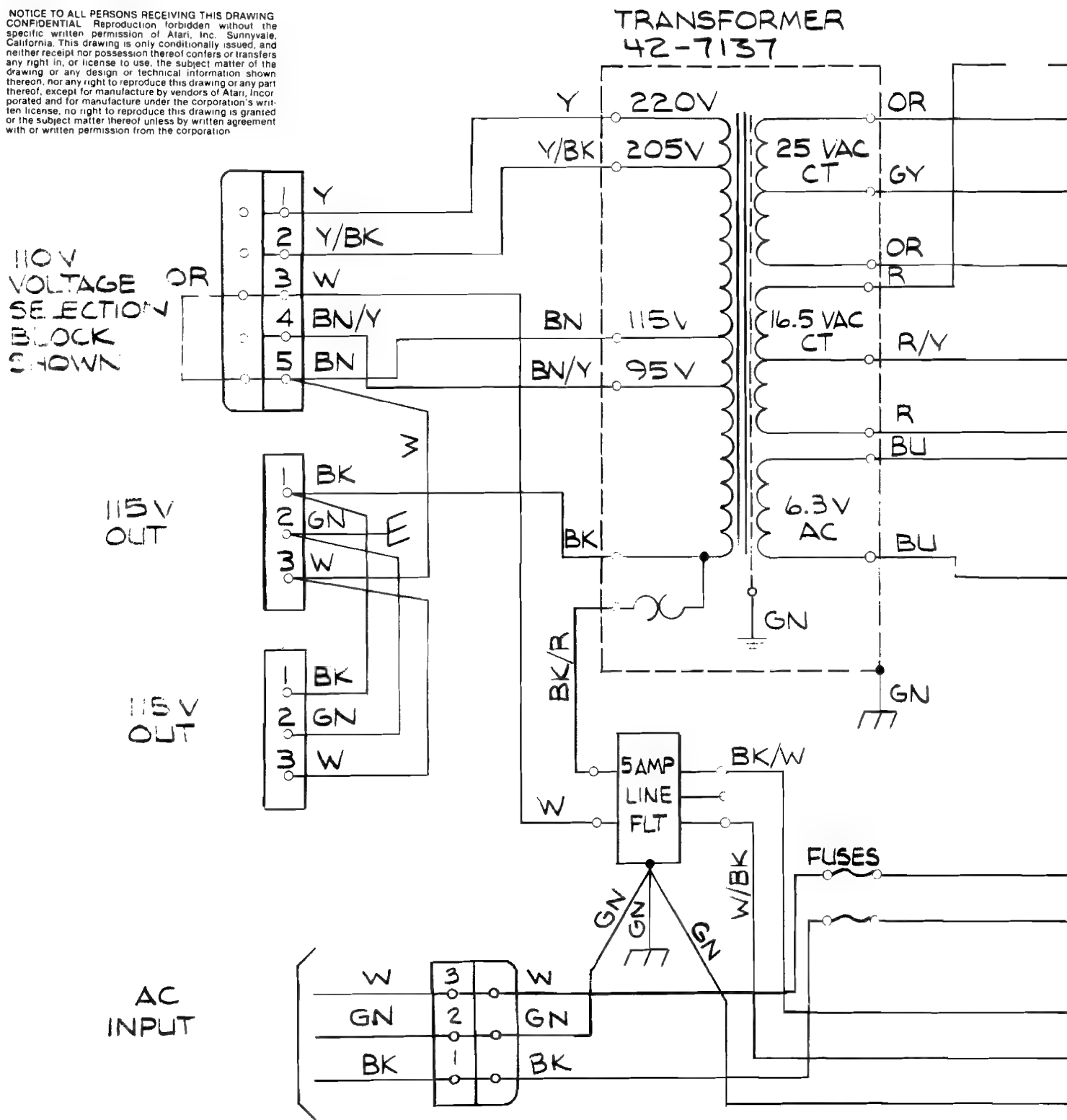


Figure 4-7 Coin Door Schematic  
 030401-01 B





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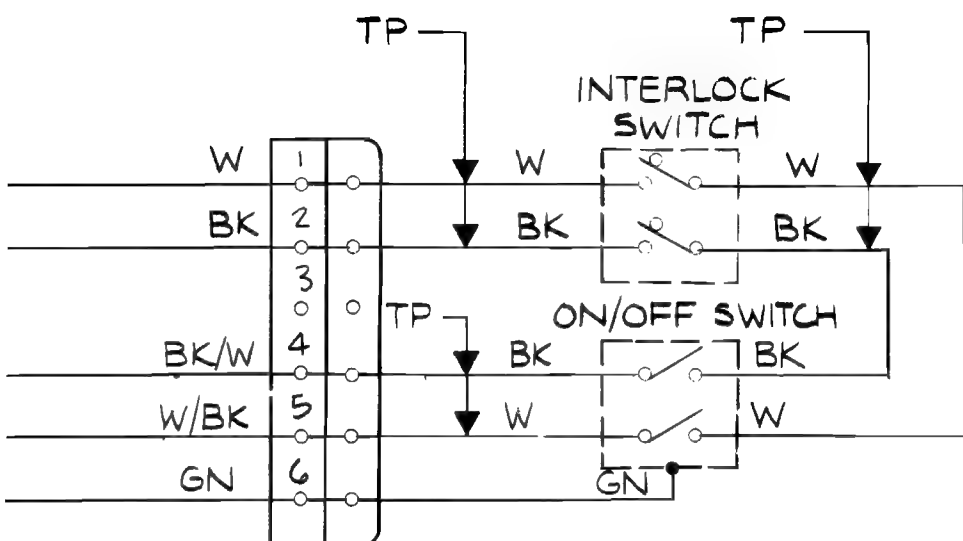
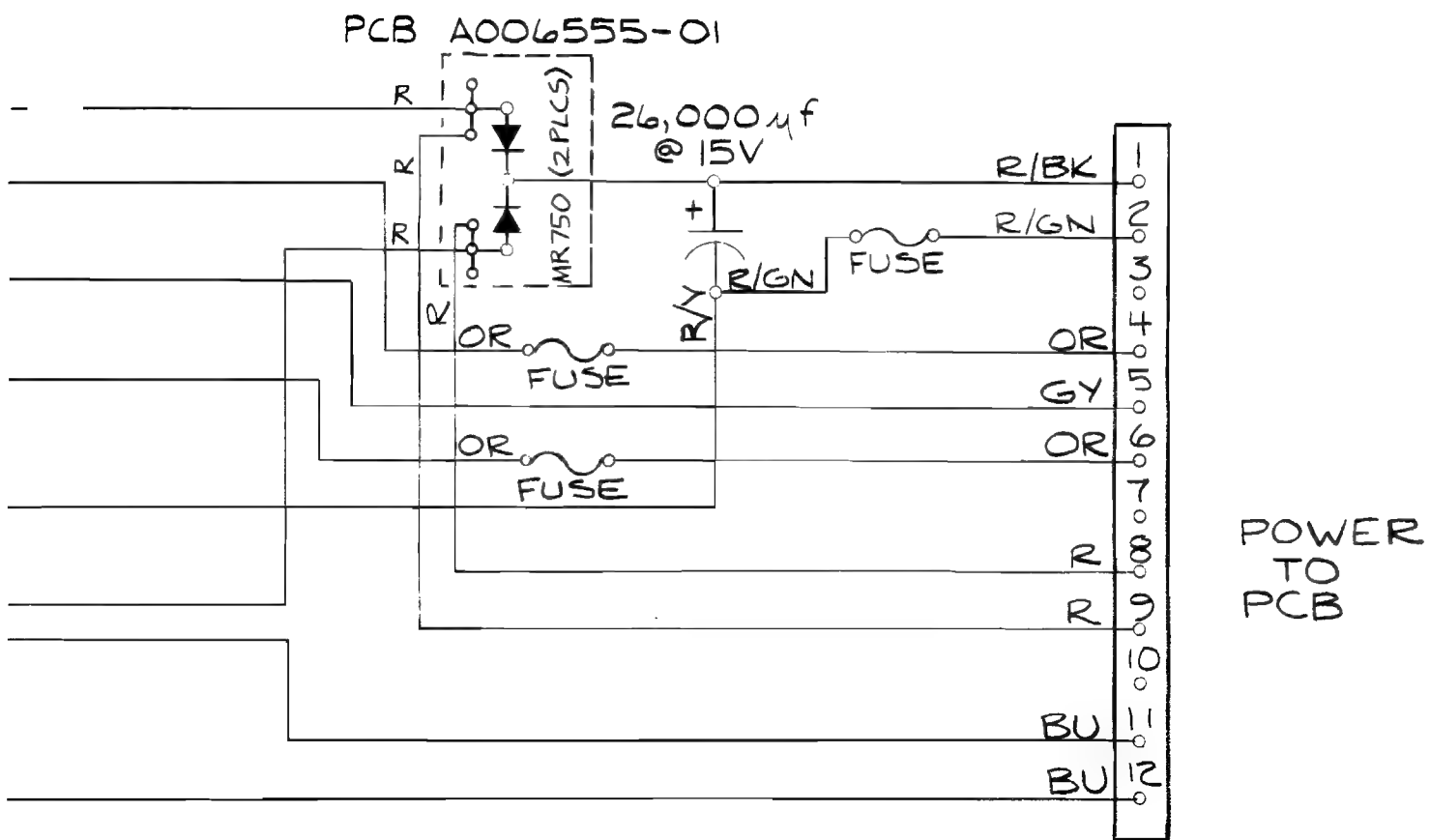
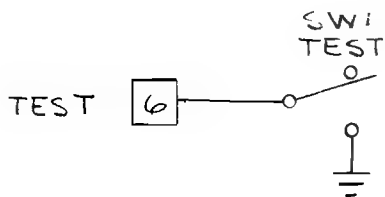
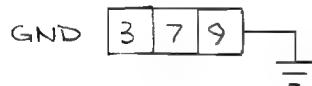
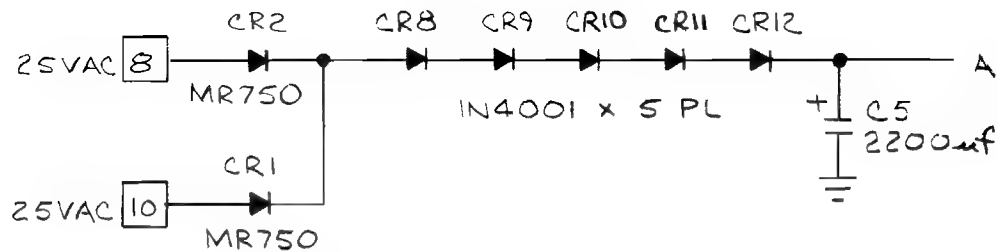
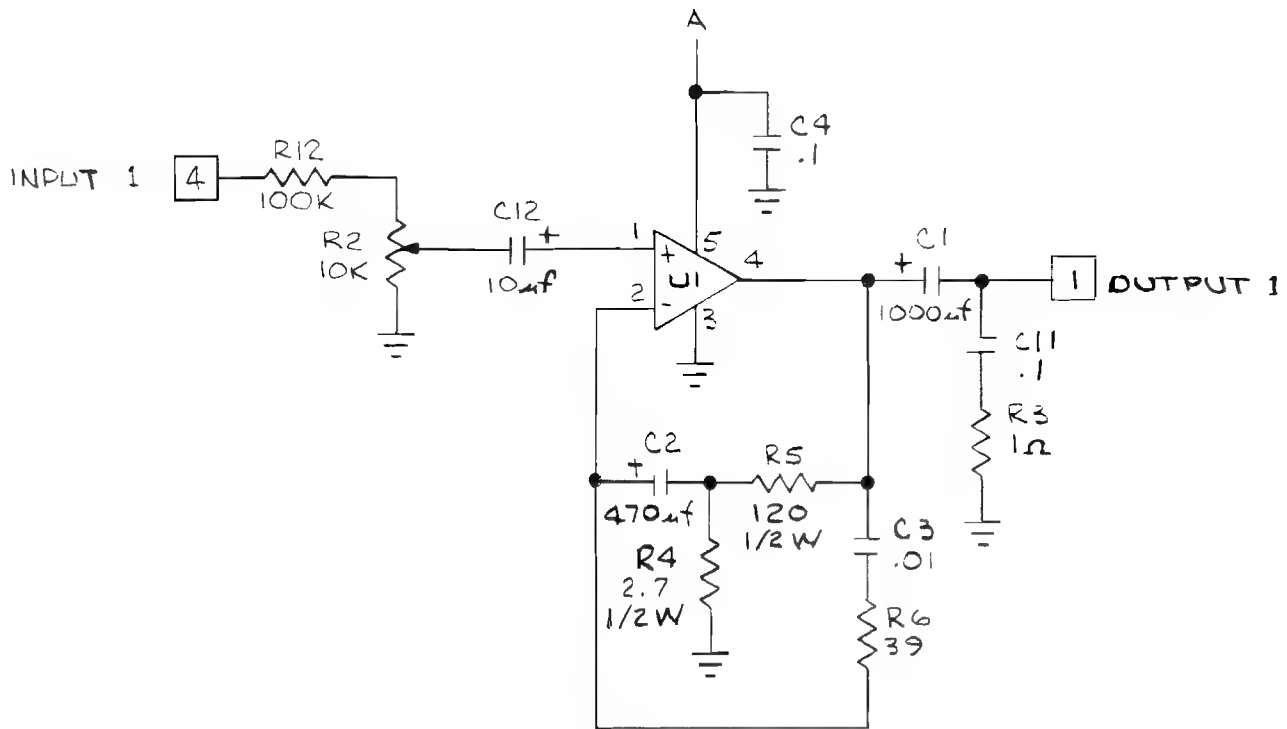
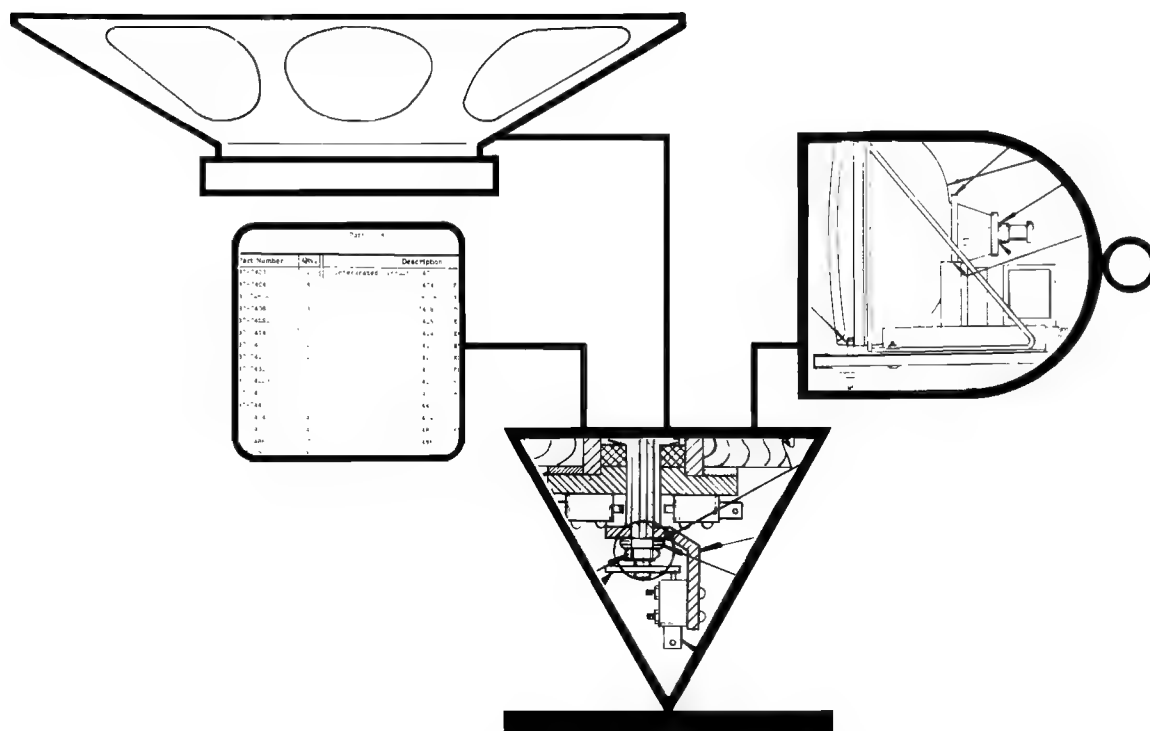


Figure 4-8 Type B Power Supply Schematic Diagram  
007197-01 C



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Figure 4-9 Single Audio Amplifier Schematic Diagram

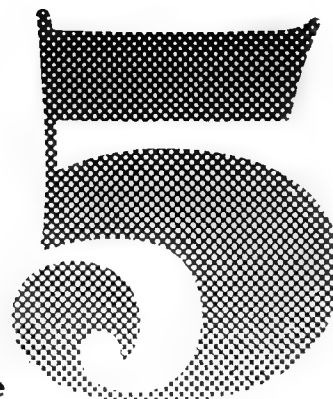


# ILLUSTRATED PARTS CATALOG

The purpose of this chapter is to provide you with the necessary information for ordering replacement parts for the Smokey Joe game.

When ordering parts from your distributor, give the part number, part name, applicable figure number of this catalog, and the serial number of your Fire Truck game. This will help to avoid confusion and mistakes in your order. We hope the results will be less downtime and more profit from your game.

**Smokey Joe**



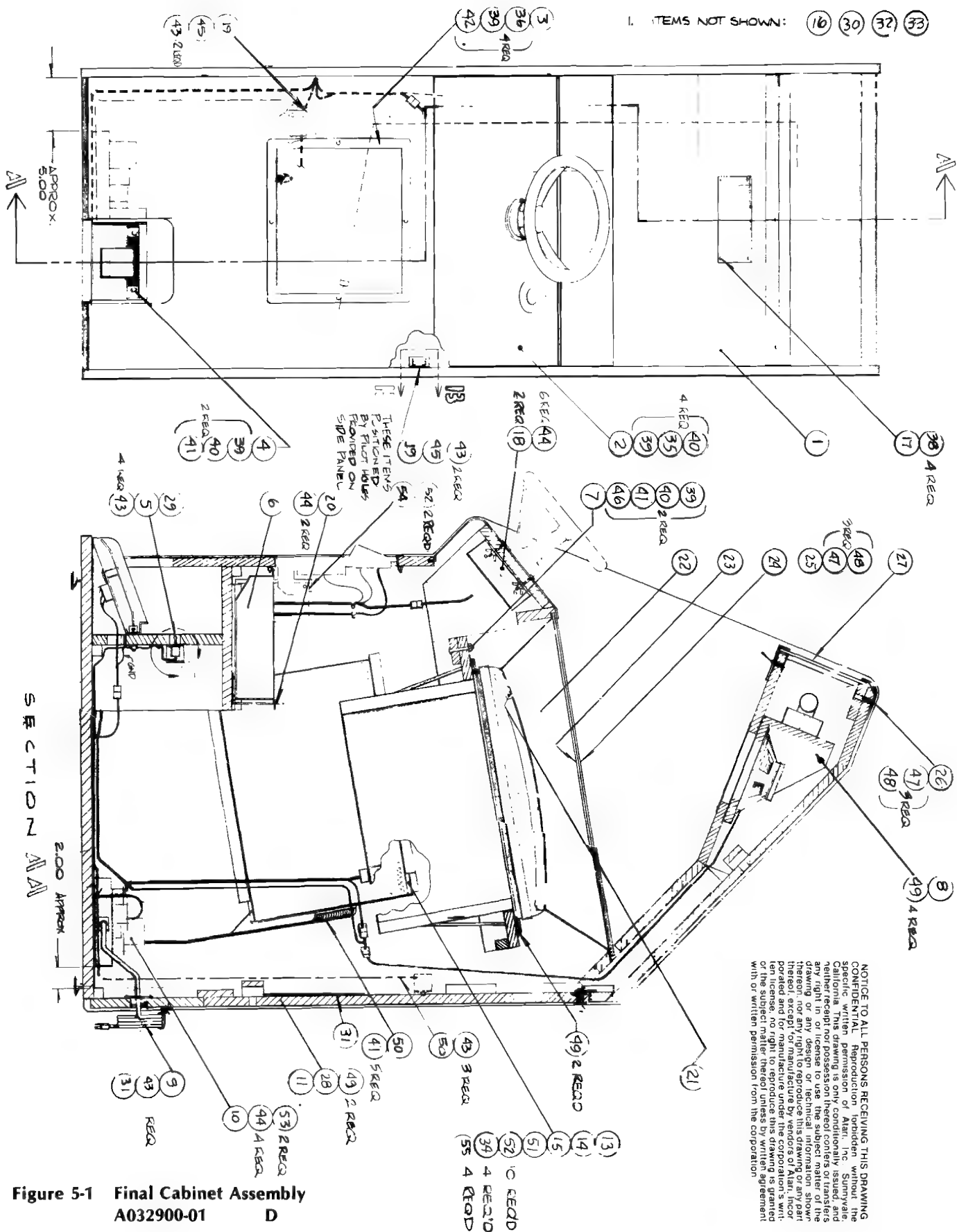


Figure 5-1 Final Cabinet Assembly  
A032900-01 D

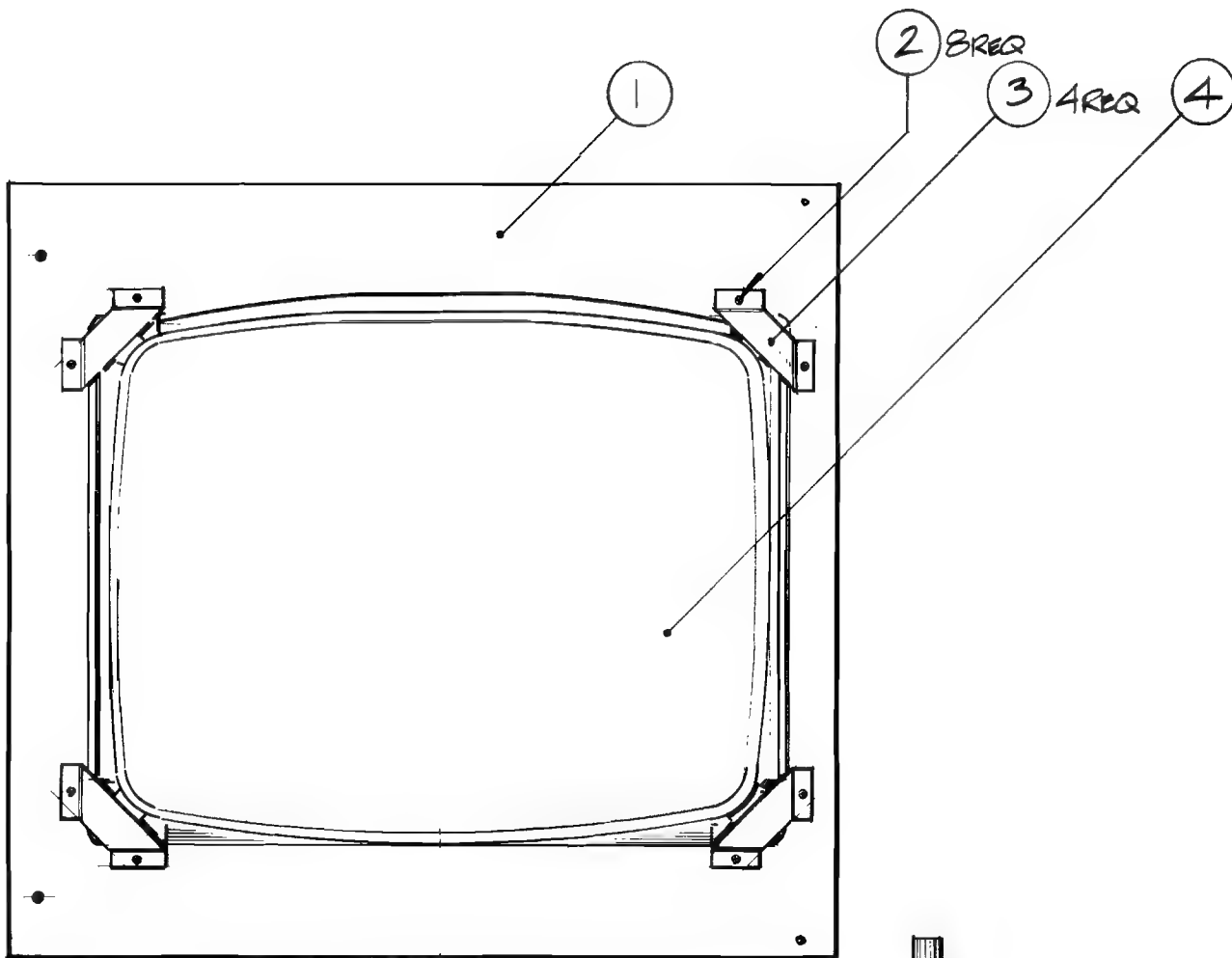


Figure 5-1 Final Cabinet Assembly  
Parts List

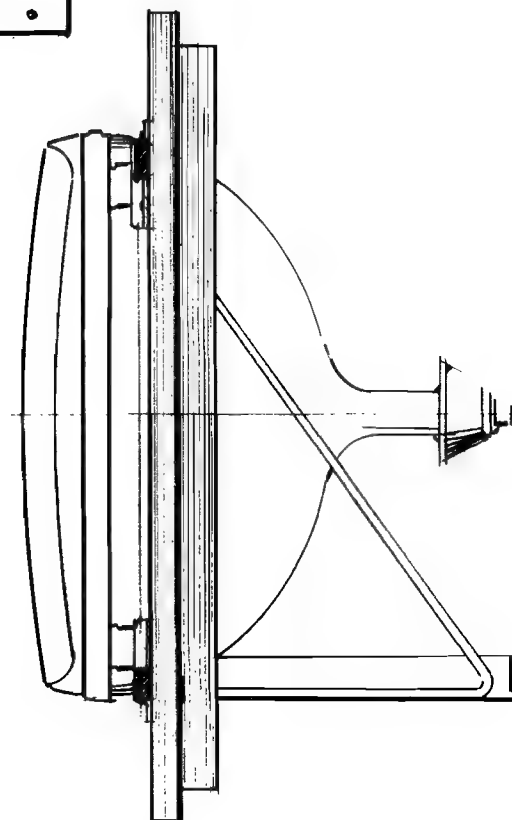
| Item | Part Number | Qty. | Description                           |
|------|-------------|------|---------------------------------------|
| 1    | A032890-02  | 1    | Assembly, Cabinet W/Graphics          |
| 2    | A032888-01  | 1    | " Control Panel W/Graphics            |
| 3    | A009083-01  | 1    | " Coin Door                           |
| 4    | A008845-01  | 1    | " Single Foot Pedal W/Harness         |
| 5    | A006449-01  | 1    | " On-Off Switch                       |
| 6    | A007902-01  | 1    | " Cash Box                            |
| 7    | A008766-01  | 1    | " T.V. Tray                           |
| 8    | A005430-01  | 1    | " Display                             |
| 9    | A033016-01  | 1    | " Power Cord                          |
| 10   | A007197-01  | 1    | " Power Supply Type "B"               |
| 11   | A007299-01  | 1    | " Rear Door W/Lock                    |
| 12   |             |      |                                       |
| 13   | A030867-01  | 1    | " R.F. Box Shield Assy                |
| 14   | A030928-01  | 1    | " R.F. Shield P.C.B.                  |
| 15   | A030926-01  | 1    | " P.C. Board (FIRETRUCK)              |
| 16   | A009424-XX  | 1    | " Shipping Container                  |
| 17   | 005419-01   | 1    | Gill, Speaker                         |
| 18   | 001638-01   | 2    | Bracket, Panel Mtg                    |
| 19   | 000268-02   | 2    | " Switch Mtg                          |
| 20   | 006870-01   | 1    | " Coin Box                            |
| 21   | 006319-03   | 1    | Decal, Copyright                      |
| 22   | 008767-01   | 1    | Bezel, Cardboard                      |
| 23   | 008759-02   | 1    | Plex, Monitor (Smoke)                 |
| 24   | 032895-01   | 1    | Plex, Monitor W/Graphics              |
| 25   | 003053-01   | 1    | Retainer, Upper Plex                  |
| 26   | 008764-01   | 1    | " Plex                                |
| 27   | 032894-01   | 1    | Plex Display W/Graphics               |
| 28   | 005233-01   | 1    | Seal Rear Door                        |
| 29   | 007103-01   | 1    | Cover, On-Off Switch                  |
| 30   | 006305-01   | 1    | Bag, Printed Poly                     |
| 31   | ST-116      | 1    | Self Test Chart                       |
| 32   | TM-116      | 1    | Tech. Manual & Illustrated Parts Cat. |
| 33   | 81-702      | 2    | TRIP-N-TELL Indicator                 |
| 34   | 78-24007    | 4    | Cable Tie, Heat Stabilized            |
| 35   | 75-935      | 4    | Wing Nut, #4-20                       |
| 36   | 75-990505S  | 4    | Nut, Lock, Shallow Pattern #4-20      |
| 37   | 78-25001    | 1    | Tie Wrap, Screw Down                  |
| 38   | 73-77015    | 4    | Pop Rivet, 3/16 O.D. x .68" Lg, 1/8"  |
| 39   | 75-015S     | 12   | Washer, Flat, 1/8"                    |

Warner Communications Company

| Item | Part Number | Qty. | Description                                      |
|------|-------------|------|--|
| 40   | 75-045      | 8    | Washer, Split-Lock 1/8"                          |
| 41   | 75-915S     | 4    | Nut, Hex, #4-20                                  |
| 42   | 75-5516B    | 4    | Bolt, Carriage #4-20 x 1.00" Lg, Blk             |
| 43   | 72-6610     | 21   | Screw, Sht. Met., Pan Hd, Phil, #6 x 5/8 Lg      |
| 44   | 72-6812     | 12   | " " " " " #8 x 3/4 Lg                            |
| 45   | 68-002      | 2    | Switch, AC Power Interlock                       |
| 46   | 75-5532N    | 2    | Bolt, Carriage, #4-20 x 2.00 Lg                  |
| 47   | 75-99090006 | 6    | Well-Nut, Blind Hole Fastener, #10-32            |
| 48   | 82-8016     | 6    | Screw, Button Hd, Socket Cap, #10-32 x 1.00" Lg. |
| 49   | 82-1824     | 8    | Screw, Wood, Flat Hd, Phil, #8 x 1.50" Lg.       |
| 50   | A032839-02  | 1    | Assembly Main Harness                            |
| 51   | 72-6808     | 1    | Screw, Sht. Met., Pan Hd Phil #8 x 1/2" Lg       |
| 52   | 72-6608     | 12   | " " " " " #6 x 1/2" Lg                           |
| 53   | 46-201202   | 2    | Fuses, Slow Acting (2 AMP)                       |
| 54   | A009574-01  | 1    | Assembly, Audio-AMP PCB                          |
| 55   | 72-1406S    | 4    | Screw, Mach., #4-40 X 3/8" Lg.                   |



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**Figure 5-2 TV Tray Assembly**  
**A008766-01 C**





Figure 5-2 TV Tray Assembly  
Parts List

| Item | Part Number | Qty. | Description                                  |
|------|-------------|------|--|
| 1    | 008755-01   | 1    | T.V. Tray                                    |
| 2    | 72-6812     | 8    | Screws, Self-Tapping, #8 x 3/4 Phil. Pan Hd. |
| 3    | 005594      | 4    | Monitor Tie Down                             |
| 4    | 90-032      | 1    | T.V. Motorola 23" (M7000-155)                |



A Warner Communications Company

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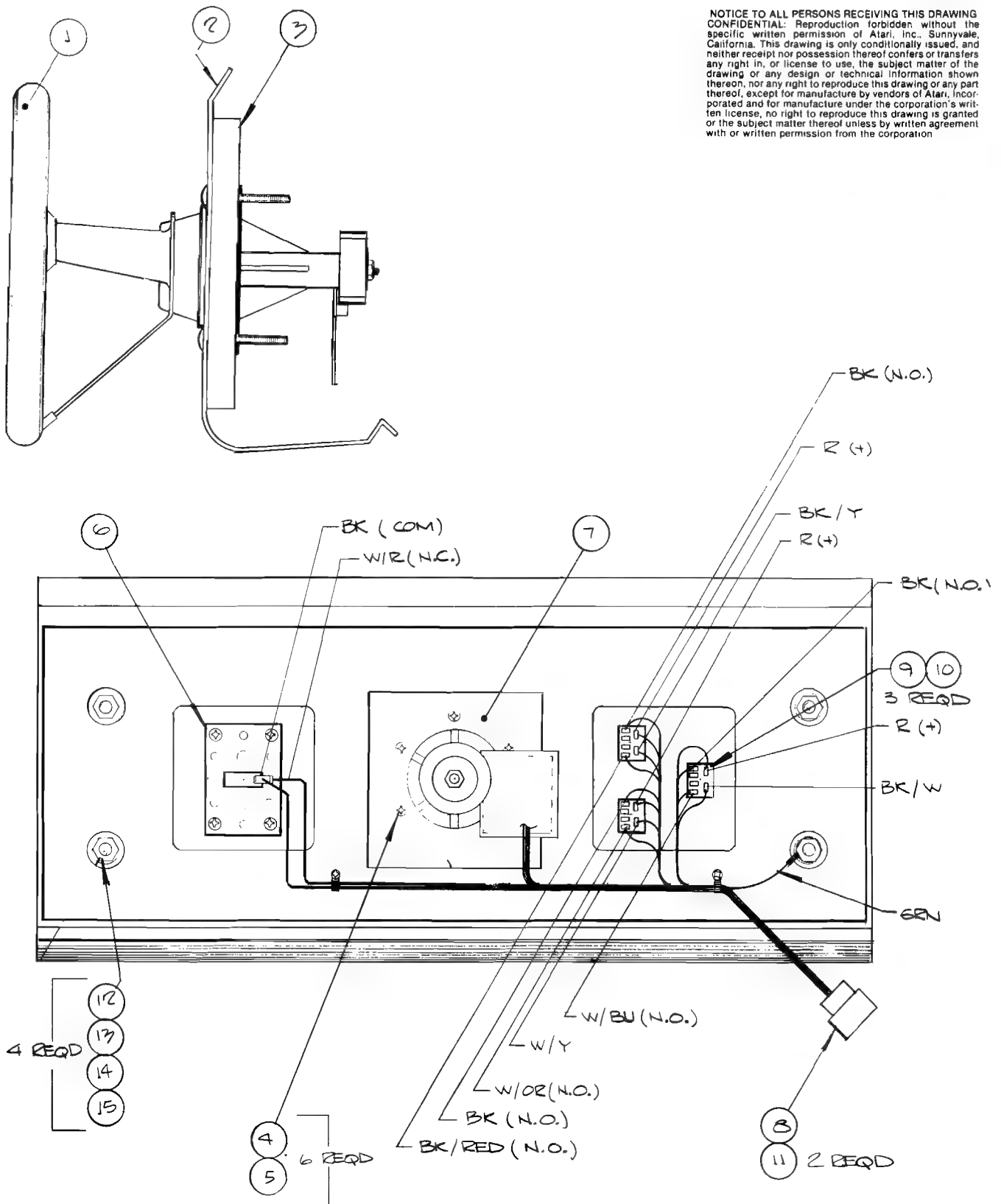
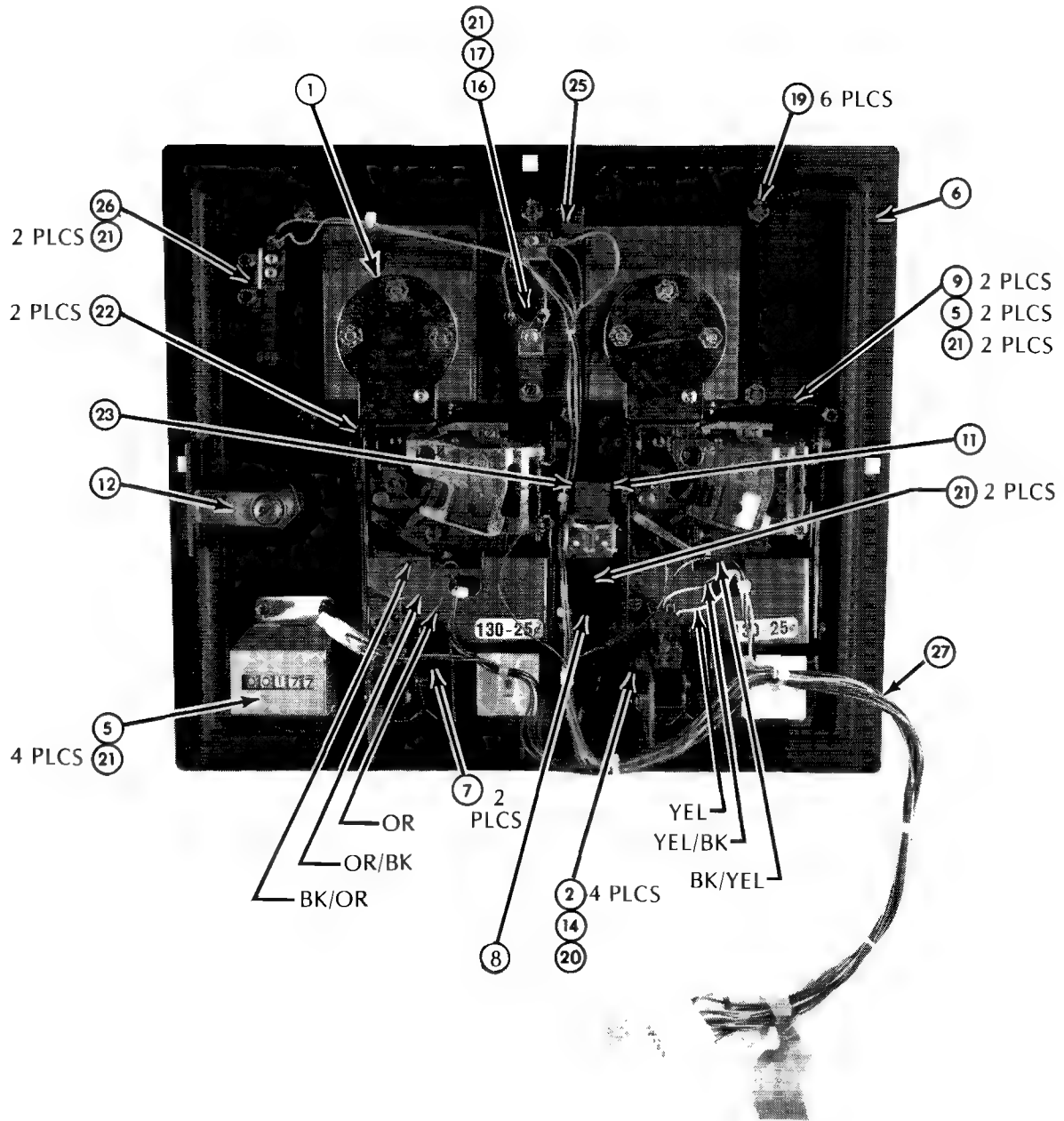


Figure 5-3 Control Panel Assembly  
 A032888-01 B



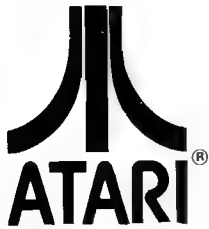
**Figure 5-3 Control Panel Assembly  
Parts List**

| Item | Part Number | Qty. | Description   |
|------|-------------|------|---|
| 1    | A000598-03  | 1    | Steering Wheel Assy   |
| 2    | 032892-01   | 1    | Control Panel W/Graphics  |
| 3    | 032893-01   | 1    | Control Panel Back-Up   |
| 4    | 85-22F112   | 6    | Mach. Screw, #10-24 x 3/4" Lg Pan Hd, Phil.Type "F"             |
| 5    | 75-040      | 6    | Washer, Split-Lock, #10   |
| 6    | A009338-01  | 1    | Start Button Assy   |
| 7    | 000567      | 1    | Bow Washer  |
| 8    | A032856-01  | 1    | Control Panel Harness Assy                                      |
| 9    | 001856-01   | 3    | Bezel, Switch   |
| 10   | 62-002      | 3    | Switch, Licon (LED)   |
| 11   | 72-6610     | 2    | Screw, SM., Pan Hd, Phil, #6 x 5/8" Lg                          |
| 12   | 75-5524B    | 4    | Bolt, Carriage, # $\frac{1}{4}$ -20 x 1 $\frac{1}{2}$ " Lg, Blk |
| 13   | 75-015S     | 4    | Washer, Flat, $\frac{1}{4}$ "                                   |
| 14   | 75-915S     | 4    | Nut, Hex, # $\frac{1}{4}$ -20                                   |
| 15   | 75-045      | 4    | Washer, Split-Lock, # $\frac{1}{4}$ -20                         |



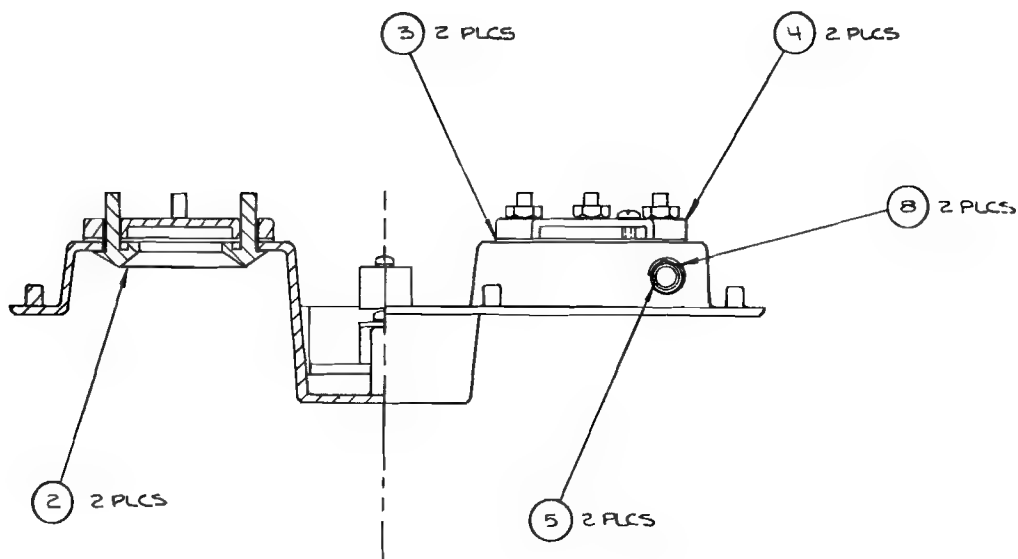
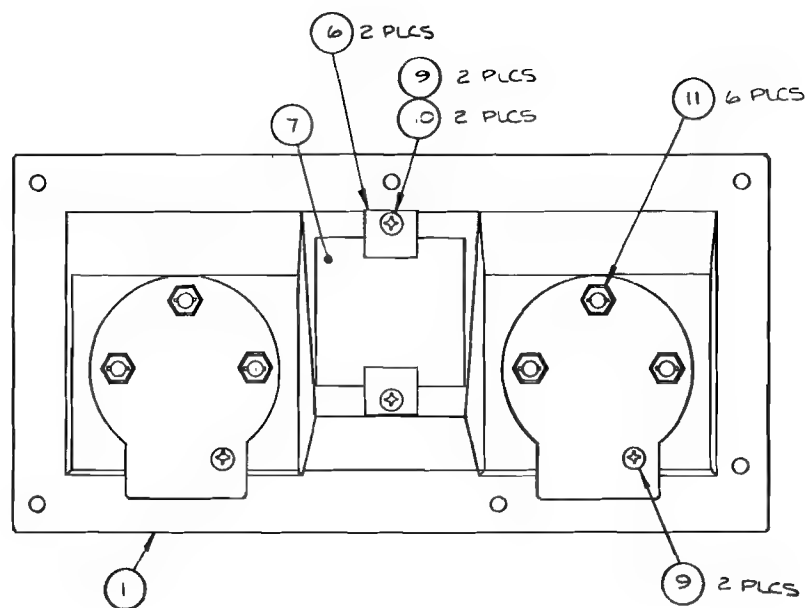
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**Figure 5-4 Coin Door Assembly**  
**A009083-01 C**



**Figure 5-4 Coin Door Assembly  
Parts List**

| Item | Part Number        | Qty. | Description  |
|------|--------------------|------|--|
| 1    | A007637-01         | 1    | Front Bezel Assy. - Used only on -01 Coin Door Assy. |
|      | A007637-02         | Ref. | Front Bezel Assy. - Used only on -02 Coin Door Assy. |
|      | A007637-03         | Ref. | Front Bezel Assy. - Used only on -03 Coin Door Assy. |
|      | A007637-04         | Ref. | Front Bezel Assy. - Used only on -04 Coin Door Assy. |
|      | A007637-05         | Ref. | Front Bezel Assy. - Used only on -05 Coin Door Assy. |
|      | A007637-06         | Ref. | Front Bezel Assy. - Used only on -06 Coin Door Assy. |
|      | A007637-07         | Ref. | Front Bezel Assy. - Used only on -07 Coin Door Assy. |
|      |                    |      | <b>See Figure 5-14</b>                               |
| 2    | 75-9165            | 4    | Nut <b>6-32</b>                                      |
| 3    | <b>A030362</b> -01 | 1    | Coin Lock-Out Assembly <b>See Figure 5-15</b>        |
| 4    | A007640-01         | 2    | Coin Switch Assembly <b>See Figure 5-16</b>          |
| 5    | A002465-01         | 1    | Coin Counter Assembly                                |
| 6    | 004320-01          | 1    | Coin Door Weldment                                   |
| 7    | 004341-01          | 2    | Secondary Coin Chute                                 |
| 8    | 004344-01          | 1    | Key Loop   |
| 9    | 004340-01          | 2    | Spring-Return  |
| 10   | 004337-01          | 2    | Bracket, Wire Form                                   |
| 11   | 004338-01          | 1    | Lock-Out, Wire Form, R.H.                            |
| 12   | 004336-01          | 1    | Lock-Out, Wire Form, L.H.                            |
| 13   | 004326-01          | 2    | Button, Scavenger                                    |
| 14   | 75-046             | 4    | Lock Washer, #6                                      |
| 15   | 006904-01          | 2    | Spacer   |
| 16   | 007359-01          | 1    | Lamp Socket  |
| 17   | 70-11-47           | 1    | Lamp   |
| 18   | 73-3008            | 2    | Retaining "C" Ring, Truarc #5103-25                  |
| 19   | 75-9914001         | 6    | Self-Threading Nut, Tinnerman #SR188006              |
| 20   | 75-026S            | 4    | Washer #6  |
| 21   | 75-00516           | 13   | Kepnut, Style 842, Std., 6-32                        |
| 22   | 008629-01          | 2    | Spring   |
| 23   | 71-2118            | 1    | Lock Assembly, Hudson Lock                           |
| 24   | 71-1225CU          | 2    | Coin Mechanism for American Quarter only             |
|      | 71-125FB           | Ref. | Coin Mechanism for Belgian 5 Francs Only             |
|      | 71-1205FF          | Ref. | Coin Mechanism for German Mark only                  |
|      | 71-1201MG          | Ref. | Coin Mechanism for Swedish Krona Only                |
|      | 71-1201KS          | Ref. | Coin Mechanism for Japanese 100 Yen Only             |
|      | 71-1210PE          | Ref. | Coin Mechanism for English 10 Pence Only             |
|      | 71-1220CA          | Ref. | Coin Mechanism for Australian 20-Cent Piece only     |
| 25   | 007753-01          | 1    | Plate, Anti-Probe                                    |
| 26   | A007638-01         | 1    | Switch Assembly - Slam                               |
| 27   | A006921-01         | 1    | Harness Assembly                                     |



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**Figure 5-5 Front Bezel Assembly**  
**A007637-01 thru -07**

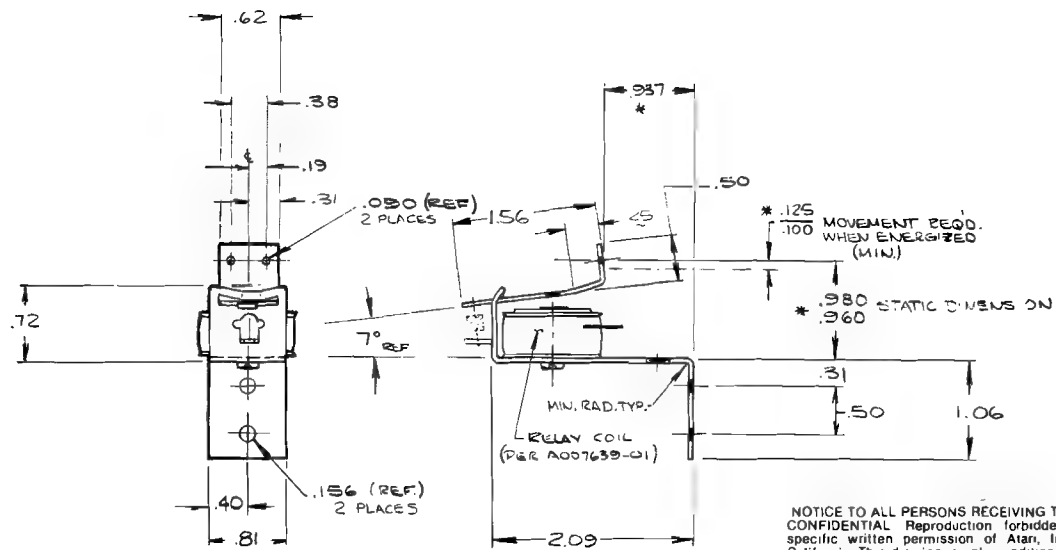
**D**



Figure 5-5 Front Bezel Assembly  
Parts List

| Item | Part Number | Qty. | Description                              |
|------|-------------|------|--|
| 1    | 004328-01   | 1    | Bezel                                    |
| 2    | See Below   | 2    | Ring                                     |
| 3    | 004331-01   | 2    | Coin Shield                              |
| 4    | 004332-01   | 2    | Primary Coin Chute                       |
| 5    | 004327-01   | 2    | Bearing, Scavenger Button                |
| 6    | 004329-01   | 2    | Clamp, Price Plate                       |
| 7    | See Below   | 1    | Price Plate                              |
| 8    | 73-3009     | 2    | Retaining "C" Ring, Truarc #5103-37      |
| 9    | 72-1604S    | 4    | Mach. Scr., 6-32 x 1/4 Lg. Pan Hd., Phil |
| 10   | 75-046      | 2    | Washer, #6, Split-Lock                   |
| 11   | 75-9914001  | 6    | Self-Threading Nut, Tinnerman #SR188006  |

| DASH NO | ITEM 2    | ITEM 7    | DENOMINATION |
|---------|-----------|-----------|--------------|
| -01     | 004330-01 | 004343-01 | 25¢          |
| -02     | 004330-01 | 004343-06 | 5 FR         |
| -03     | 009153-01 | 004343-04 | 1 DM         |
| -04     | 004330-01 | 004343-03 | 1 KR         |
| -05     | 009720-01 | 004343-05 | 100 Y        |
| -06     | 007752-01 | 004343-02 | 10 P         |
| -07     | 007752-01 | 004343-07 | 20¢ AUST.    |

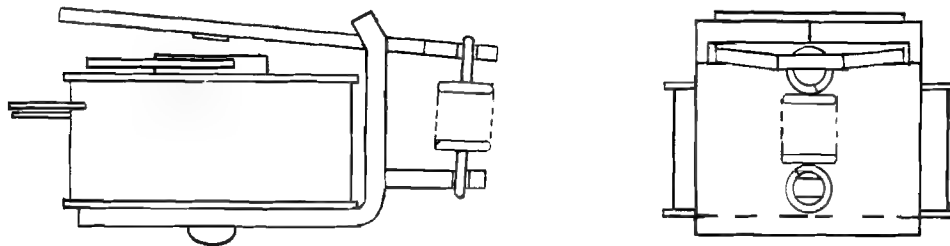


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2. BREAK & DEBURR ALL SHARP CORNERS
3. DIMENSIONS TAKEN FROM TOOLED PART. DIMENSIONS WITH (\*) ARE SPECIFIED DIMS REQUIRED IN TOOLING BY ENGINEERING TO HAVE PART INTERCHANGE W/PRIOR BUYOUT PART.
4. COIL DATA 10VDC  $\pm 2$ , 50  $\Omega$  RES, CURRENT 200 mA MAX.
5. MFR: COIN MECH, INC. (VENDOR)

#### Detail of Relay Coil (A007639-01)



| COIL DATA |                |
|-----------|----------------|
| VOLTAGE   | 10 VDC $\pm 2$ |
| RES       | 50 $\Omega$    |
| CURRENT   | 200 mA MAX     |

Figure 5-6 Coin Lockout Assembly  
A030362-01 A



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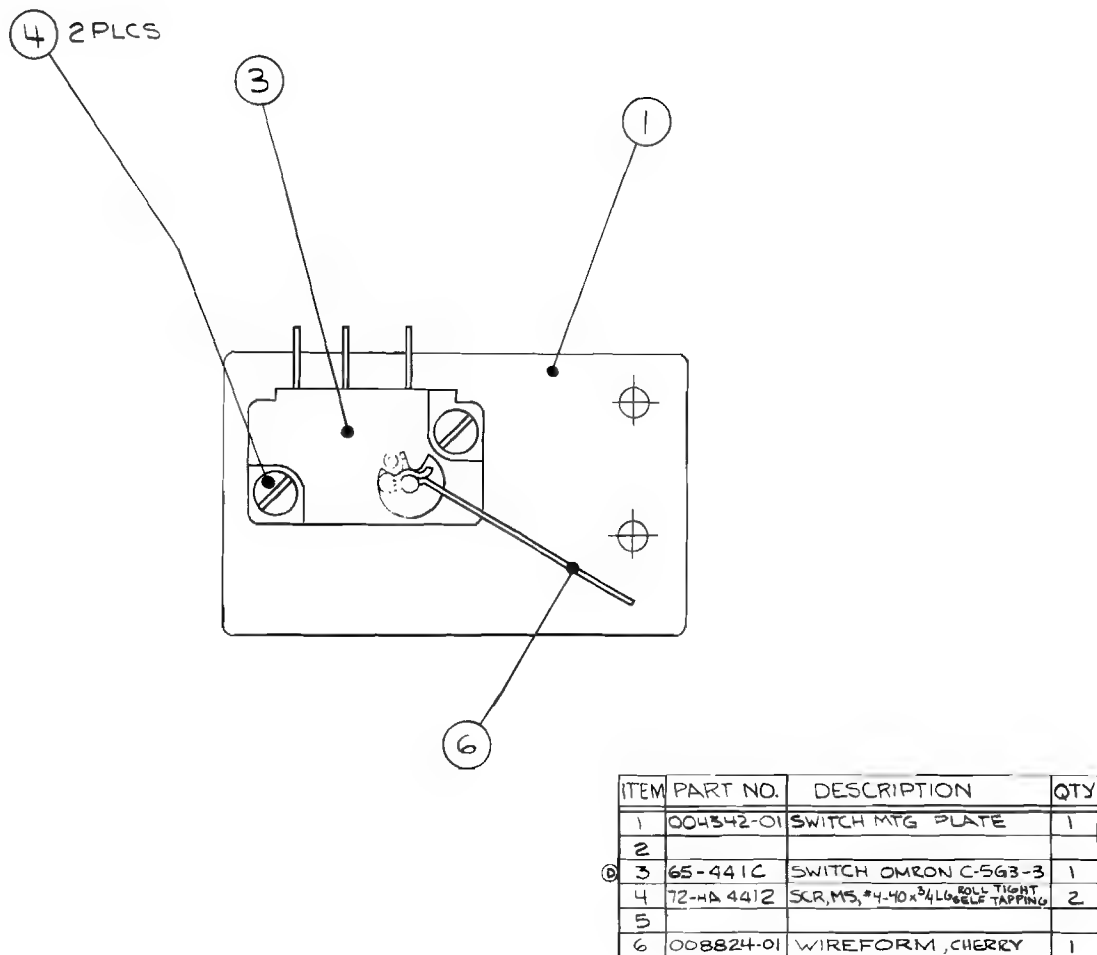


Figure 5-7 Coin Switch Assembly  
 A007640-01 D

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F11

F12

F13

F14

F15

F16

W

BLK

GRN

R/GN

OR

2 REQD

3 REQD

4 REQD

8 REQD

NOTES:

1. FUSES WILL BE LISTED ON THE FINAL ASSEMBLY PARTS LIST OF EACH INDIVIDUAL GAME.

NOTES:

1. FUSES WILL BE LISTED ON THE FINAL ASSEMBLY PARTS LIST OF EACH INDIVIDUAL GAME.
2. SEE 007197-01 FOR POWER SUPPLY SCHEMATIC (TYPE B)

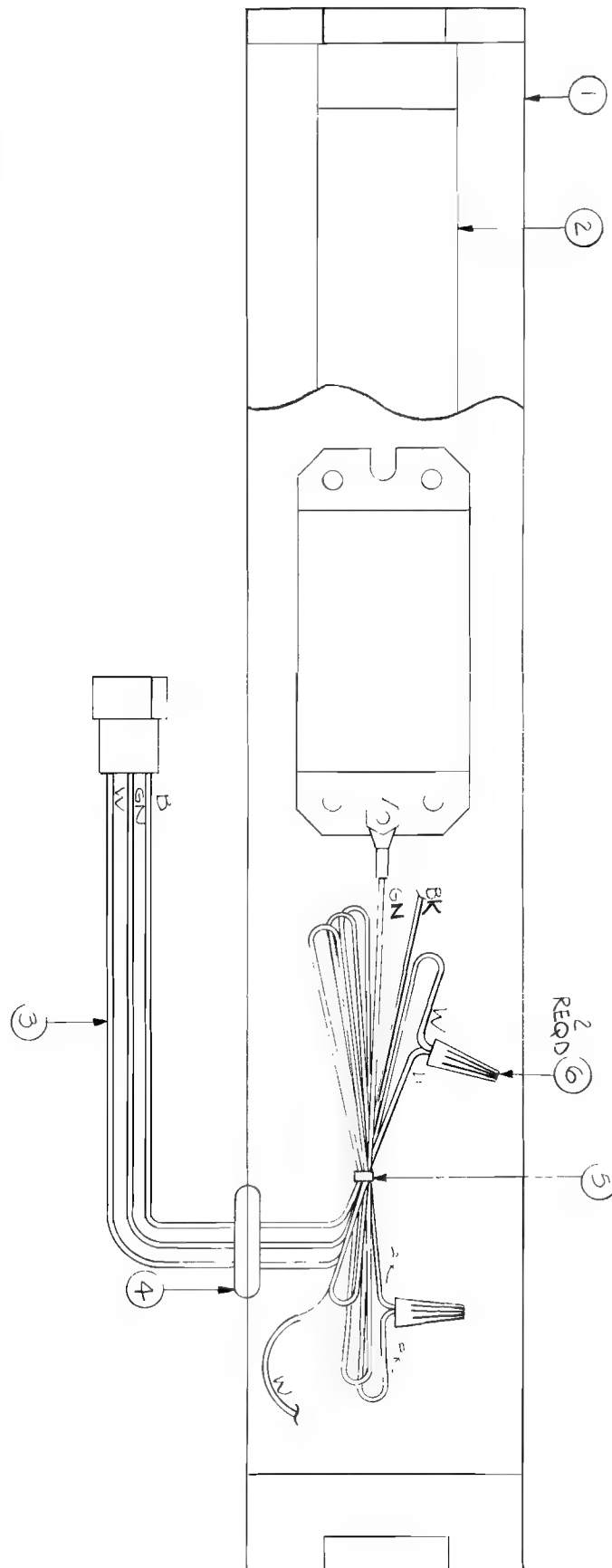


Figure 5-8 Type B Power Supply Assembly  
Parts List

| Item | Part Number | Qty. | Description                              |
|------|-------------|------|--|
| 1    | 009575-01   | 1    | P.C. Board                               |
| 2    | 10-51P0     | 1    | Res, Carbon, 5%, 1/4W, 1 Ohm R3          |
| 3    | 10-5390     | 1    | " " " " 39 " R6                          |
| 4    | 11-52P7     | 1    | " " " 1/2W, 2.7 " R4                     |
| 5    | 11-5121     | 1    | " " " " 120 " R5                         |
| 6    | 19-316103   | 1    | Trimpot, 10K Ohm R2                      |
| 7    | 24-250106   | 1    | Cap, Electrolytic, 25V, 10uf C12         |
| 8    | 24-250477   | 1    | " " " 470uf C2                           |
| 9    | 24-250108   | 1    | " " " 1000uf C1                          |
| 10   | 24-250228   | 1    | " " " 2200uf C5                          |
| 11   | 27-250103   | 1    | " Ceramic, " .01uf C3                    |
| 12   | 27-250104   | 2    | " " " .1uf C4,11                         |
| 13   | 31-MR750    | 2    | Diode, MR750 CR1,2                       |
| 14   | 31-1N4001   | 5    | " 1N4001 CR8-12                          |
| 15   | 37-TDA2002V | 1    | Audio Amp, TDA2002V U1                   |
| 16   | 69-004      | 1    | Switch, Slide SW1                        |
| 17   | 78-58005    | 1    | Connector, 10-Position                   |
| 18   | 030184-01   | 1    | Heatsink                                 |
| 19   | 72-1604C    | 3    | Screw, P.H., Phil, #6-32 x 1/4 Lg , Cres |
| 20   | 75-056      | 3    | Washer, Lock, Int Star #6                |
| 21   | 78-16009    | 1    | Silpad                                   |
| 22   | 10-5104     | 1    | Res, Carbon, 5%, 1/4W, 100K OHM R12      |

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**Figure 5-9 Fluorescent Light Assembly**  
**A005495-01 A**

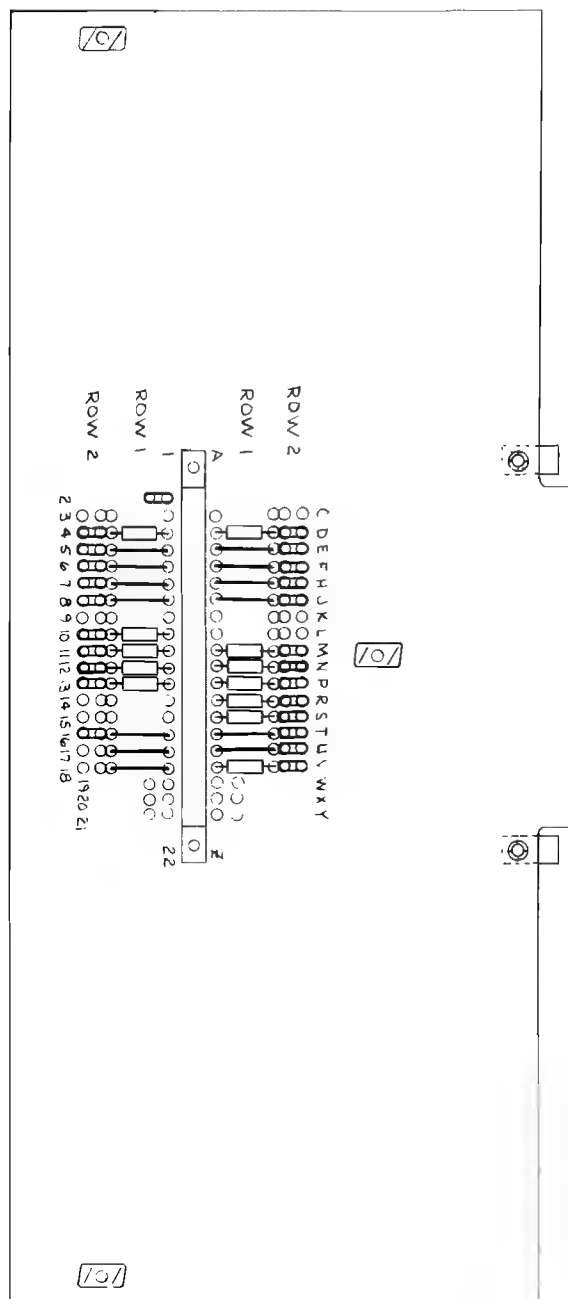
**POW**



Figure 5-9 Fluorescent Light Assembly  
Parts List

| Item | Part Number | Qty. | DESCRIPTION                              |
|------|-------------|------|--|
| 1    | 93-104      | 1    | Gibson Fluorescent Fixture 18 inch       |
| 2    | 70-303      | 1    | Fluorescent Tube 18 inch (or Equivalent) |
| 3    | A005493-01  | 1    | Fluorescent Light Harness                |
| 4    | 78-2652     | 1    | Grommet, Rubber                          |
| 5    | 78-24001    | A/R  | Tie Wrap                                 |
| 6    | 79-561816   | 2    | Wire Nut, Ideal 71-B                     |

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| CONN.   | ROW 1    |        |           | ROW 2     |
|---------|----------|--------|-----------|-----------|
| PIN NO. | INDUCTOR | JUMPER | CAPACITOR | CAPACITOR |
| A       |          |        |           |           |
| B       |          |        |           |           |
| C       |          |        |           |           |
| D       | 100uH    |        |           | .1        |
| E       |          | X      |           | .1        |
| F       |          | X      |           | .1        |
| H       |          | X      |           | .1        |
| J       |          | X      |           | .1        |
| K       |          |        |           |           |
| L       |          |        |           |           |
| M       | 100uH    |        |           | .1        |
| N       | 100uH    |        |           | .1        |
| P       | 100uH    |        |           | .1        |
| R       | 100uH    |        |           | .1        |
| S       | 100uH    |        |           | .1        |
| T       |          | X      |           | .1        |
| U       |          | X      |           | .1        |
| V       | 100uH    |        |           | .1        |
| W       |          |        |           |           |
| X       |          |        |           |           |
| Y       |          |        |           |           |
| Z       |          |        |           |           |
| 1       |          |        |           |           |
| 2       |          |        | .1        |           |
| 3       |          |        |           |           |
| 4       | 100uH    |        |           | .1        |
| 5       |          | X      |           | .1        |
| 6       |          | X      |           | .1        |
| 7       |          | X      |           | .1        |
| 8       |          | X      |           | .1        |
| 9       |          |        |           |           |
| 10      | 100uH    |        |           | .1        |
| 11      | 100uH    |        |           | .1        |
| 12      | 100uH    |        |           | .1        |
| 13      | 100uH    |        |           | .1        |
| 14      |          |        |           |           |
| 15      |          |        |           |           |
| 16      |          | X      |           | .1        |
| 17      |          | X      |           |           |
| 18      |          | X      |           |           |
| 19      |          |        |           |           |
| 20      |          |        |           |           |
| 21      |          |        |           |           |
| 22      |          |        |           |           |

Figure 5-10 R.F. Shield PCB Assembly  
 A030928-01 A

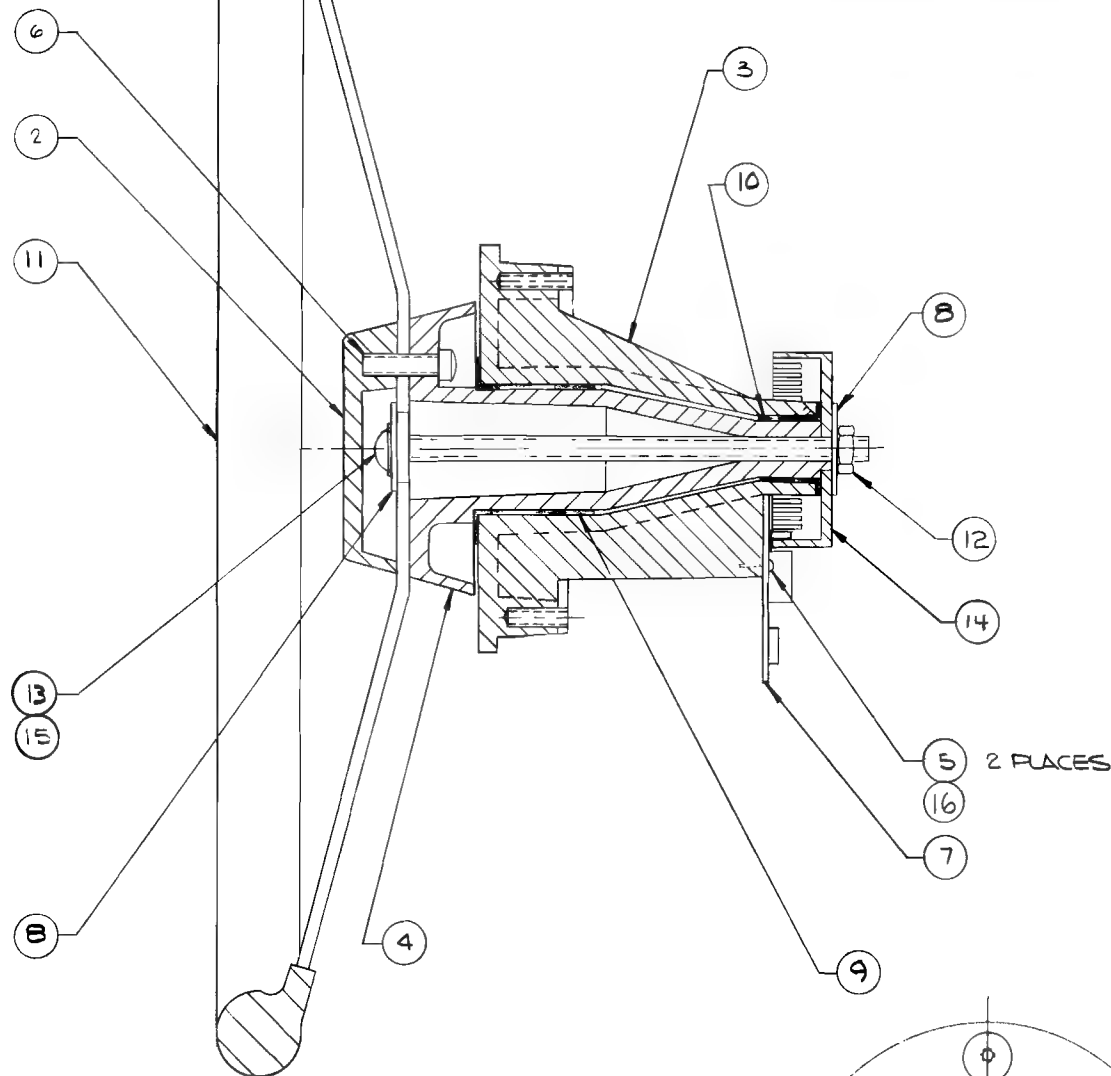


Figure 5-10 RF Shield PCB Assembly  
Parts List

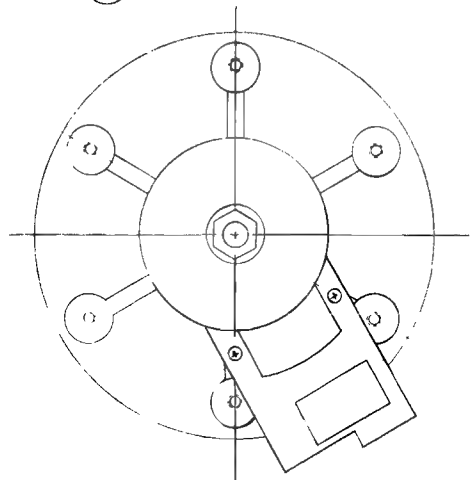
| Item | Part Number | Qty. | Description                      |
|------|-------------|------|----------------------------------|
| 1    | 030835-01   | 1    | P.C. Board                       |
| 2    | 2D-1016     | 24   | Cap., Monolythic, 0.1uf, 50 V    |
| 3    | 41-3003     | 12   | Inductor, 100uH                  |
| 4    | 52-003      | 13   | Jumper, .600 Centers             |
| 5    | 75-E6106081 | 3    | Wing Screw, #6-32 x 1/2" LG      |
| 6    | 75-992302   | 3    | Fastener, 1/4 Turn, #6-32, Nylon |
| 7    | 79-517222   | 1    | Connector, 44 Pin P.C. Mount     |
| 8    | 030868-01   | 2    | Mount, Connector                 |

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3 PLACES



2 PLACES



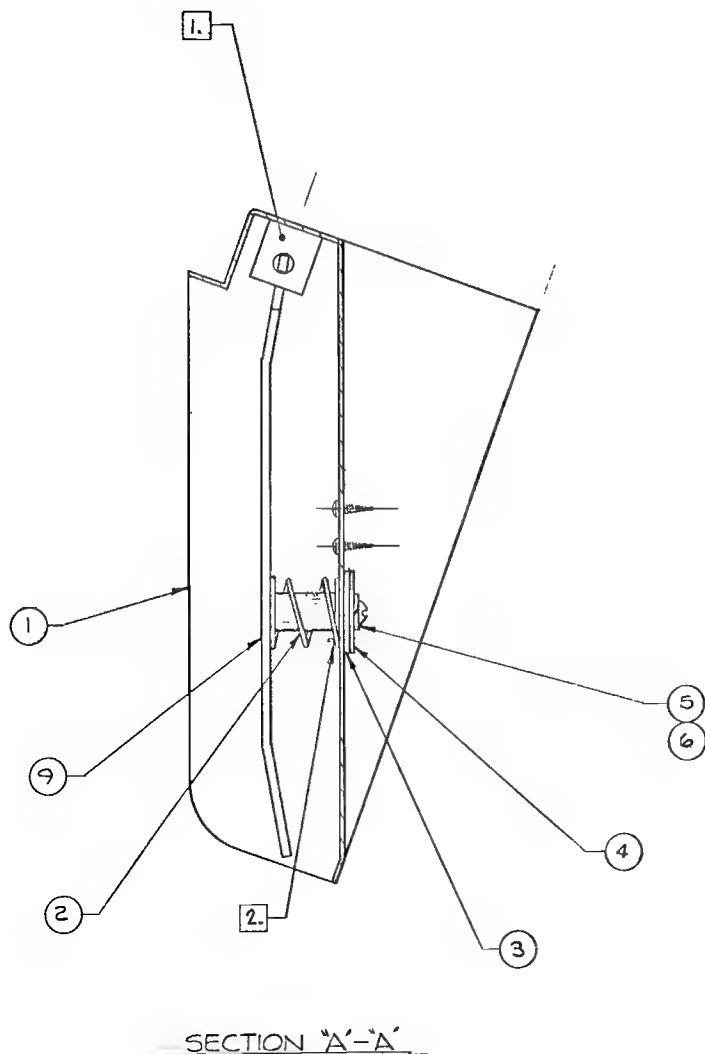
**Figure 5-11 Steering Wheel Assembly**  
**A000598-01 R**



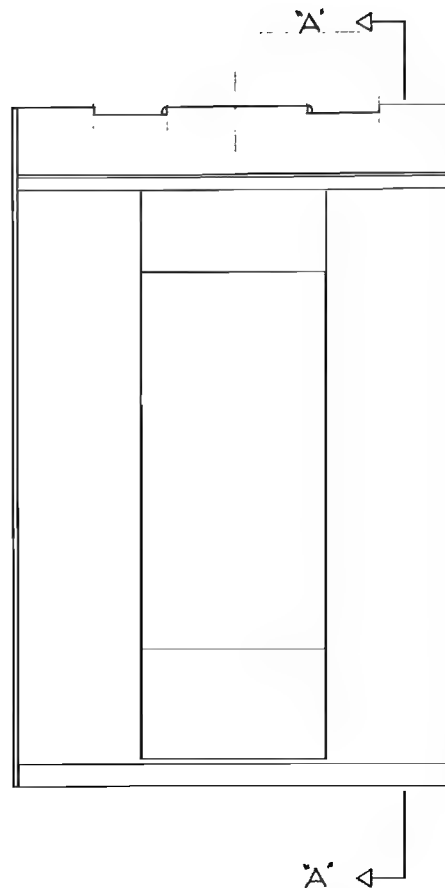


**Figure 5-11 Steering Wheel Assembly**  
**A000598-01 R**

| Item | Part Number | Qty. | DESCRIPTION                                     |
|------|-------------|------|---|
| 1    | A000598-03  | Ref  | Steering Wheel Assembly                         |
| 2    | 000599-02   | 1    | Cover, Atari Logo                               |
| 3    | 000605      | 1    | Housing   |
| 4    | 000606      | 1    | Shaft   |
| 5    | 85-22F206   | 2    | Scr. Sht. Metal, #2-56 X 3/8 'F' Type           |
| 6    | 72-7512     | 3    | Mach Scr, 1/4-20 x 3/4 Lg, Fillister Hd Slotted |
| 7    | A000607     | 1    | Printed Circuit Assembly                        |
| 8    | 75-07002    | 2    | Washer, Fender, 1/4                             |
| 9    | 76-092020   | 1    | Bearing, Thompson (20L20-FK)                    |
| 10   | 76-091010   | 1    | Bearing, Thompson (10L10-FK)                    |
| 11   | 78-40104    | 1    | Steering Wheel, 10"                             |
| 12   | 75-990505 S | 1    | Nut, 1/4-20, Nylon Lock, Shallow Pattern        |
| 13   | 72-9580     | 1    | Mach Scr, 1/4-20 x 5 Lg, Truss Hd, Slotted      |
| 14   | 000616      | 1    | Hub Light                                       |
| 15   | 75-055      | 1    | Washer, 1/4" Int. Tooth, Starlock               |
| 16   | 75-042      | 2    | Washer, Split Lock #2                           |



1. TAB TO BE BENT AT 90° ANGLE WITH BASE, ACTING AS HINGE BRACKET FOR FOOT PEDAL.
2. SPRING SHOULD HOOK OVER TAB.



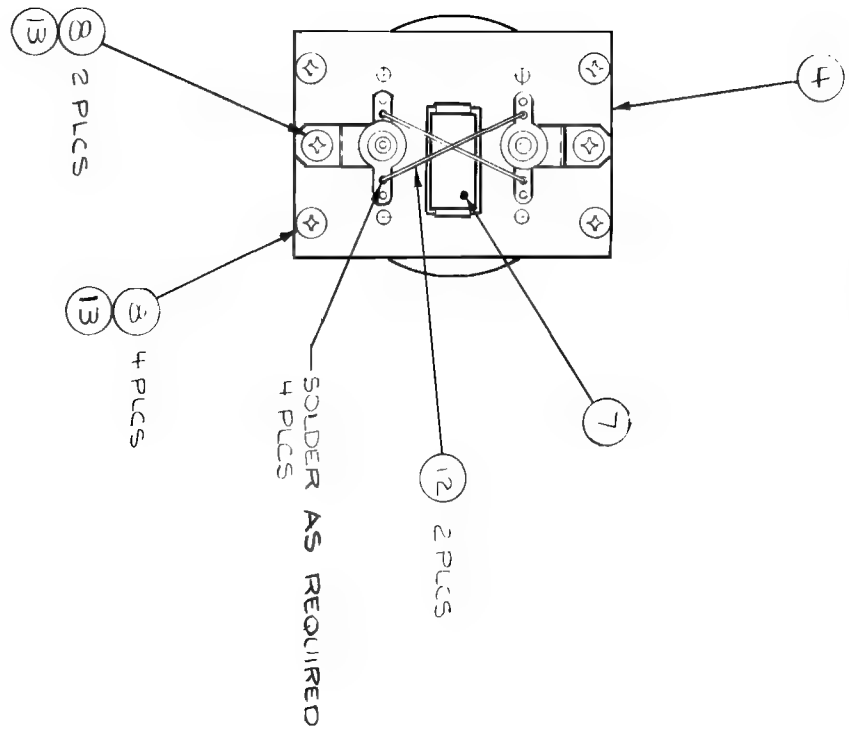
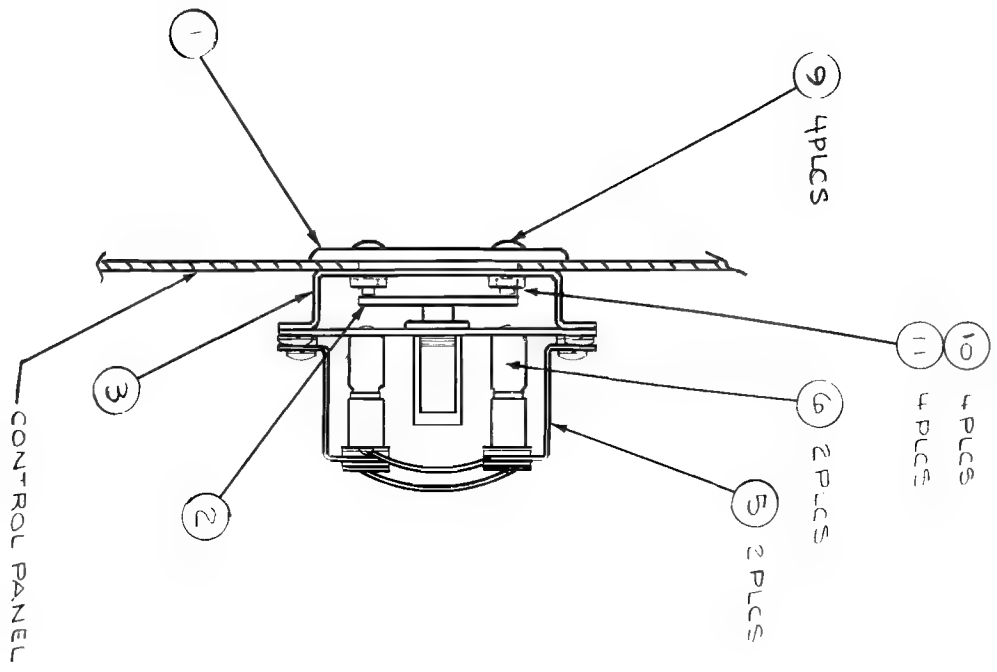
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**Figure 5-12 Foot Pedal Assembly**  
**A007183-01 C**



Figure 5-12 Foot Pedal Assembly  
Parts List

| Item | Part Number | Qty. | Description                                       |
|------|-------------|------|---|
| 1    | A007184-01  | 1    | Weldment, Foot Pedal, Base                        |
| 2    | 000592      | 1    | Spring  |
| 3    | 003546      | 1    | Washer, Rubber, (.50 ID x 1.25 OD x .12 Thk)      |
| 4    | 75-07002    | 1    | Washer, Steel, ( $\frac{1}{2}$ x 1.250 Wide)      |
| 5    | 72-1508S    | 1    | Mach., Screw, $\frac{1}{4}$ -20 x .50 Pan Hd Phil |
| 6    | 75-045      | 1    | Washer, Lock, # $\frac{1}{4}$                     |
| 7    |             |      |   |
| 8    |             |      |   |
| 9    | A007136-01  | 1    | Weldment, Foot Pedal                              |



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Figure 5-13 Start Button Assembly  
 A007357-01 D



**Figure 5-13 Start Button Assembly  
Parts List**

| Item | Part Number | Qty. | Description                                 |
|------|-------------|------|---|
| 1    | 006530 -01  | 1    | Bezel                                       |
| 2    | 006535 -01  | 1    | Button                                      |
| 3    | 006532 -01  | 1    | Chassis                                     |
| 4    | A006533-01  | 1    | Switch Mtg. Plate Assembly                  |
| 5    | 79-4317     | 2    | Lamp Socket                                 |
| 6    | 70-11-47    | 2    | Lamp  |
| 7    | 62-020      | 1    | Switch, Cherry, E68-50A                     |
| 8    | 72-1603     | 6    | Mach Screw, 6-32 x 3/16 Lg, Pan Hd, Phil.   |
| 9    | 82-8808     | 4    | Screw, Button hd socket 8-32x 1/2"lg. Black |
| 10   | 75-918S     | 4    | Nut, 3-32                                   |
| 11   | 75-048      | 4    | Washer, #8, Split-Lock                      |
| 12   | 004577-19   | 2    | Jumper Wire, Black                          |
| 13   | 75-046      | 6    | Washer, Split-Lock #6                       |

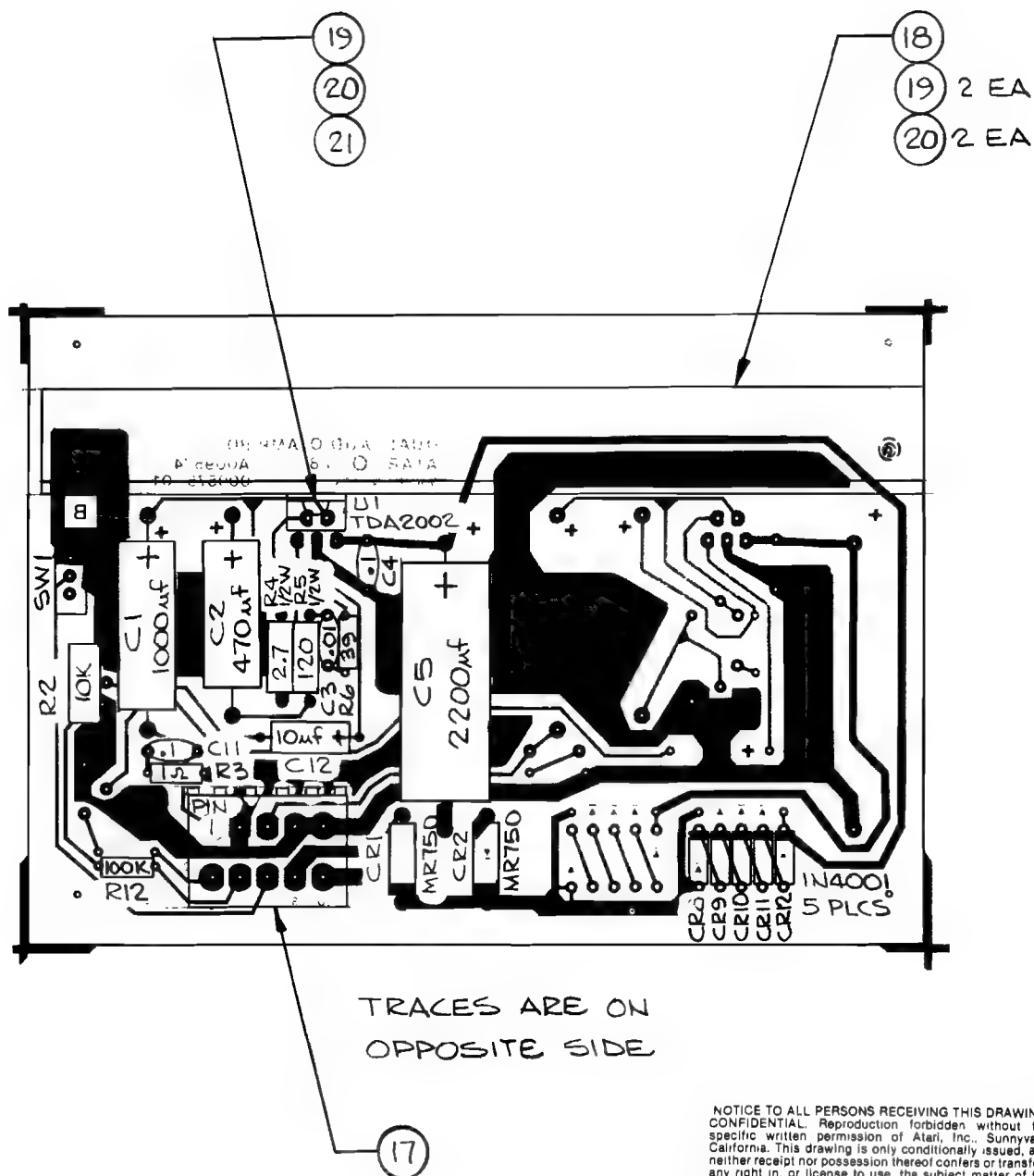
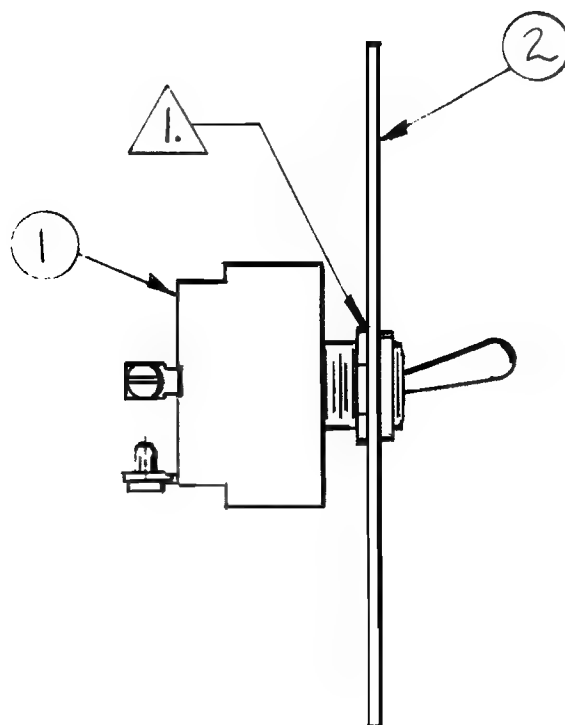
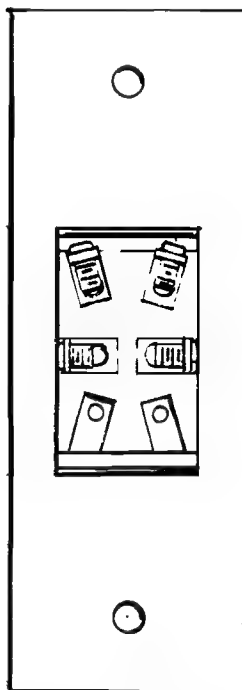


Figure 5-14 Single Audio Amplifier PCB Assembly  
A009574-01 B



Figure 5-14 Single Audio Amp PCB Assembly  
Parts List

| Item | Part Number | Qty. | Description                               |
|------|-------------|------|---|
| 1    | A009266-01  | 1    | Power Supply Base Weldment Assembly       |
| 2    | A006886-01  | 1    | Transformer Termination Assembly "Type B" |
| 3    | 29-053      | 1    | Cap., Sprague Electrolytic 26,000uf @ 15V |
| 4    | 78-70501SC  | 1    | Brkt., Cap. Mtg. Sprague #4586-48         |
| 5    | A006555-01  | 1    | P.C. Board Rectifier                      |
| 6    |             |      |   |
| 7    | 79-4411004  | 5    | Fuse Holder, Panel Mounting               |
| 8    | 41-2003     | 1    | Filter, Power Line, 5 AMP                 |
| 9    | A006958-01  | A/R  | Volt Sel Block 95V                        |
| 10   | A006958-02  | "    | Volt Sel Block 110V                       |
| 11   | A006958-03  | "    | Volt Sel Block 205V                       |
| 12   | A006958-04  | "    | Volt Sel Block 220V                       |
| 13   | 78-2708     | 1    | Grommet, Plastic                          |
| 14   | 72-1810S    | 9    | Screw Pan Hd., #8-32 x 5/8"Lg.            |
| 15   |             |      |   |
| 16   | 75-048      | 9    | Washer, Split-Lock #8                     |
| 17   | 75-918S     | 9    | Nut Hex #8                                |
| 18   | 75-018S     | 8    | Washer Flat #8                            |
| 19   | A007192-01  | 1    | Power Switch Termination                  |
| 20   | A007444-01  | 1    | Power In Harness                          |
| 21   | 46-203801   | 1    | Fuse, 8 AMP, 125V, 3 AG Fast Acting       |
| 22   | 46-201251   | 2    | Fuse, 2½ AMP, 125V, Slow Acting           |



### NOTES

1. POSITION HEX NUT APPROX. AS SHOWN.
2. HARDWARE FOR MOUNTING SWITCH IS INCLUDED WITH SWITCH

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**Figure 5-15 On/Off Switch Assembly**  
**A006449-01 A**



### Figure 5-15 On/Off Switch Assembly Parts List

| Item | Part Number | Qty. | DESCRIPTION                               |
|------|-------------|------|---|
| 1    | 61-062A     | 1    | Toggle Switch, DPST Carling Switch #2GK54 |
| 2    | 006450-01   | 1    | MTG Plate, On - Off Switch                |



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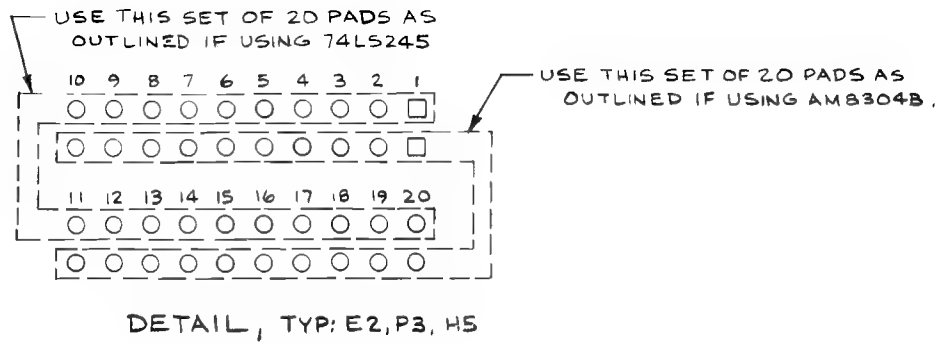


Figure 5-16 Smokey Joe PCB Assembly  
 A030926-01 and -02 A



Figure 5-16 Smokey Joe PCB Assembly  
Parts List -01 Version

| Item | Part Number | Qty. | Description  |
|------|-------------|------|--|
| 1    | 030927-01   | 1    | P-C. BOARD   |
| 2    | 10-5101     | 4    | RES., CAR. COMP, 5%, 1/4 100 OHM R88-91                            |
| 3    | 10-5271     | 3    | " " " 270 " R8,9,41  |
| 4    | 10-5331     | 3    | " " " 330 " R16,31,33  |
| 5    | 10-5471     | 1    | " " " 470 " R32  |
| 6    | 10-5681     | 1    | " " " 680 " R64  |
| 7    | 10-5821     | 1    | " " " 820 " R51  |
| 8    | 10-5102     | 18   | " " " 1K " R1,2,15,18-20,30,34,39,57,61,67,68,76,108,109,112,14    |
| 9    | 10-5182     | 2    | " " " 1.8K " R38,40  |
| 10   | 10-5222     | 3    | " " " 2.2K " R29,36,60   |
| 11   | 10-5392     | 1    | " " " 3.9K " R35   |
| 12   | 10-5472     | 1    | " " " 4.7K " R54   |
| 13   | 10-5822     | 1    | " " " 8.2K " R37   |
| 14   | 10-5103     | 47   | " " " 10K " R3-7,10-13,17,26,56,59,62,65,69,73-75,77-87,92-107,110 |
| 15   | 10-5133     | 1    | " " " 15K " R50  |
| 16   | 10-5223     | 2    | " " " 22K " R43,55   |
| 17   | 10-5273     | 1    | " " " 27K " R58  |
| 18   | 10-5333     | 2    | " " " 33K " R53,66   |
| 19   | 10-5473     | 4    | " " " 47K " R42,70-72  |
| 20   | 10-5683     | 1    | " " " 68K " R25  |
| 21   | 10-5104     | 1    | " " " 100K " R49   |
| 22   | 10-5154     | 1    | " " " 150K " R52   |
| 23   | 10-5224     | 2    | " " " 220K " R21,48  |
| 24   | 10-5394     | 1    | " " " 390K " R44   |
| 25   | 10-5474     | 2    | " " " 470K " R22,45  |
| 26   | 10-5105     | 4    | " " " 1M " R23,28,47,63  |
| 27   | 10-5225     | 2    | RES., CAR. COMP, 5%, 1/4 2.2M " R24,46                             |
| 28   |             |      |  |
| 29   |             |      |  |
| 30   | 19-315254   | 1    | TRIMPOT, 250K OHM  |
| 31   | 19-608M4P0  | 1    | RES., WIREWOUND, 10W, 4 OHM  |
| 32   |             |      |  |
| 33   | 21-101103   | 1    | CAP., MYLAR, 100V .01uF  |
| 34   |             |      |  |
| 35   | 21-101104   | 1    | CAP., MYLAR, 100V 0.1uF  |

| Item | Part Number | Qty. | Description   |
|------|-------------|------|---|
| 36   | 24-250105   | 1    | CAP., ELECTROLYTIC 25V 1uF C41  |
| 37   | 24-250225   | 1    | " " " 2.2uF C8  |
| 38   | 24-250106   | 2    | " " " 10uF C26,30   |
| 39   | 24-250227   | 1    | CAP., ELECTROLYTIC 25V 220uF C15  |
| 40   |             |      |   |
| 41   | 27-250103   | 7    | CAP., CER. DISC. 25V .01uF C36, 44,46-49,53                                       |
| 42   | 27-250104   | 30   | CAP., CER. DISC. 25V 0.1uF C1-7,9,10,16-23,26-28,39,40,63,45,50,51,2-14,C3F-35,52 |
| 43   | 27-250224   | 6    | CAP., CER. DISC. 25V .22uF C11  |
| 44   | 29-010      | 1    | CAP., TANTALUM 10V 2.2uF C42  |
| 45   | 29-046      | 1    | CAP., TANTALUM 20V 10uF   |
| 46   |             |      |   |
| 47   | 31-1N914    | 5    | DIODE, 1N914  |
| 48   | 33-2N3644   | 2    | TRANSISTOR, 2N3644  |
| 49   | 34-2N3565   | 2    | " " 2N3565  |
| 50   | 34-2N6044   | 1    | " " 2N6044  |
| 51   | 34-MJE3300  | 1    | TRANSISTOR MJE3300  |
| 52   |             |      |   |
| 53   | 37-74LS00   | 4    | INTEGRATED CIRCUIT, 74LS00  |
| 54   | 37-74LS02   | 5    | " " 74LS02  |
| 55   | 37-74LS04   | 4    | " " 74LS04  |
| 56   | 37-74LS08   | 2    | " " 74LS08  |
| 57   | 37-74LS10   | 2    | " " 74LS10  |
| 58   | 37-74LS14   | 2    | " " 74LS14  |
| 59   | 37-74LS20   | 2    | " " 74LS20  |
| 60   | 37-74LS27   | 1    | " " 74LS27  |
| 61   | 37-74LS32   | 3    | " " 74LS32  |
| 62   | 37-7437     | 1    | " " 7437  |
| 63   | 37-74LS42   | 3    | " " 74LS42  |
| 64   | 37-74LS74   | 8    | " " 74LS74  |
| 65   | 37-74LS86   | 6    | " " 74LS86  |
| 66   | 37-74LS92   | 1    | " " 74LS92  |
| 67   | 37-74LS93   | 1    | " " 74LS93  |
| 68   | 37-74LS95   | 1    | " " 74LS95  |
| 69   | 37-7496     | 1    | " " 7496  |
| 70   | 37-74LS109  | 3    | " " 74LS109   |
| 71   | 37-74LS151  | 1    | " " 74LS151   |
| 72   | 37-74LS153  | 1    | " " 74LS153   |
| 73   | 37-74LS157  | 8    | " " 74LS157   |
| 74   | 37-74LS163  | 4    | " " 74LS163   |
| 75   | 37-74LS164  | 2    | " " 74LS164   |
| 76   | 37-74166    | 4    | " " 74166   |
| 77   | 37-74LS174  | 4    | " " 74LS174   |
| 78   | 37-74LS175  | 2    | " " 74LS175   |
| 79   | 37-74LS191  | 8    | " " 74LS191   |
| 80   | 37-74LS245  | 3    | " " 74LS245   |
| 81   | 37-74LS251  | 3    | " " 74LS251   |
| 82   | 37-74LS253  | 1    | " " 74LS253   |
| 83   | 37-74LS273  | 3    | " " 74LS273   |
| 84   | 37-74LS367  | 3    | " " 74LS367   |

**Figure 5-16 Smokey Joe PCB Assembly Parts List -01 Version**

| Item | Part Number | Qty. | Description                                      |             |
|------|-------------|------|--|-------------|
| 85   | 37-556      | 1    | TIMER, 556                                       | B9          |
| 86   | 37-LM323    | 1    | REGULATOR, LM323                                 |             |
| 87   | 37-LM324    | 1    | INTEGRATED CIRCUIT, LM324                        | E9          |
| 88   | 37-9316     | 1    | INTEGRATED CIRCUIT, 9316                         | H6          |
| 89   |             |      |  |             |
| 90   |             |      |  |             |
| 91   | 62-001      | 1    | SWITCH, SPST, MOM.                               |             |
| 92   | 66-114P1T   | 1    | SWITCH, SPST, X4, DIP                            | B3          |
| 93   | 66-118P1T   | 1    | SWITCH, SPST, X8, DIP                            | E11         |
| 94   |             |      |  |             |
| 95   | 72-1608C    | 2    | SCREW, PAN HD. PH, #6-32x $\frac{1}{2}$ LG, CRES |             |
| 96   | 75-016      | 2    | WASHER, FLAT, #6                                 |             |
| 97   | 75-056      | 2    | WASHER, LOCK, INT. STAR, #6                      |             |
| 98   | 75-916C     | 2    | NUT, #6-32, CRES                                 |             |
| 99   |             |      |  |             |
| 100  | 78-06001    | 1    | HEATSINK, LM323                                  |             |
| 101  | 78-16005    | 1    | SILPAD, LM323                                    |             |
| 102  |             |      |  |             |
| 103  | 020670-01   | 6    | TERMINAL, TEST POINT                             | TP1-6       |
| 104  | 030868-01   | 2    | MOUNT, CONNECTOR                                 |             |
| 105  |             |      |  |             |
| 106  | 79-42040    | 1    | SOCKET, 40-PIN, MED. INSERTION                   | C2          |
| 107  | 90-102      | 1    | CRYSTAL, 12.096 MHZ                              | Y1          |
| 108  |             |      |  |             |
| 109  | 90-6001     | 1    | MICROPROCESSOR                                   | C2          |
| 110  | 90-7019     | 4    | RAM, 2111A-4                                     | N2,P2,H4,J4 |
| 111  | 009114-01   | 1    | SYNC PROM  | R4          |
| 112  | 032827-01   | 1    | PROM, ALPHA-NUMERICS                             | R3          |
| 113  | 032828-01   | 1    | ROM, PLAYFIELD                                   | F5          |
| 114  | 032829-01   | 1    | TAIL ROM 1                                       | J5          |
| 115  | 032830-01   | 1    | TAIL ROM 2                                       | L5          |
| 116  | 032831-01   | 1    | CAB PROM   | P7          |
| 117  |             |      |  |             |
| 118  |             |      |  |             |
| 119  |             |      |  |             |
| 120  |             |      |  |             |
| 121  |             |      |  |             |
| 122  |             |      |  |             |
| 123  |             |      |  |             |
| 124  |             |      |  |             |
| 125  |             |      |  |             |
| 126  | 032823-01   | 1    | PROGRAM ROM 0                                    | C1          |
| 127  | 032824-01   | 1    | " " 1  | D1          |
| 128  | 032825-01   | 1    | " " 2  | F1          |
| 129  | 032826-01   | 1    | " " 3  | H1          |



Figure 5-16 Smokey Joe PCB Assembly  
Parts List -02 Version

| Item | Part Number | Qty. | Description                            |
|------|-------------|------|--|
| 1    | 030927-01   | 1    | P.C. BOARD                             |
| 2    | 10-5101     | 4    | RES., CAR. COMP, 5%, 100 OHM           |
| 3    | 10-5271     | 3    | " " " 270 " 888-91                     |
| 4    | 10-5331     | 3    | " " " 330 " 88,9,41                    |
| 5    | 10-5471     | 1    | " " " 470 " R15,31,33                  |
| 6    | 10-5681     | 1    | " " " 680 " R32                        |
| 7    | 10-5821     | 1    | " " " 820 " R64                        |
| 8    | 10-5102     | 18   | " " " 1K " R51                         |
| 9    | 10-5132     | 2    | " " " 1-RK " R1,2, 15,18-20,30,        |
| 10   | 10-5222     | 3    | " " " 2-2K " 34,39,57,61,67,68,        |
| 11   | 10-5392     | 1    | " " " 3-9K " 76,108,109,112,114        |
| 12   | 10-5472     | 1    | " " " 4-7K " R38,40                    |
| 13   | 10-5822     | 1    | " " " 8-2K " R29,36,60                 |
| 14   | 10-5103     | 47   | " " " 10K " R37                        |
| 15   | 10-5153     | 1    | " " " 15K " R3,7,10-13,17,26,56,       |
| 16   | 10-5223     | 2    | " " " 22K " 59,62,65,69,73-75,         |
| 17   | 10-5273     | 1    | " " " 27K " 77-87,92-107,110           |
| 18   | 10-5333     | 2    | " " " 33K " R50                        |
| 19   | 10-5473     | 4    | " " " 47K " R43,55                     |
| 20   | 10-5683     | 1    | " " " 68K " R58                        |
| 21   | 10-5104     | 1    | " " " 100K " R33,66                    |
| 22   | 10-5154     | 1    | " " " 150K " R42,70-72                 |
| 23   | 10-5224     | 2    | " " " 220K " R25                       |
| 24   | 10-5394     | 1    | " " " 390K " R49                       |
| 25   | 10-5474     | 2    | " " " 470K " R21,48                    |
| 26   | 10-5105     | 4    | " " " 1K " R44                         |
| 27   | 10-5225     | 2    | RES., CAR. COMP, 5%, 1/4 2-2M " R22,45 |
| 28   |             |      |  |
| 29   |             |      |  |
| 30   | 19-315254   | 1    | TRIPOT, 250K OHM                       |
| 31   | 19-80884PO  | 1    | RES., WIREBOUND, 10W, 4 OHM            |
| 32   | 21-101103   | 1    | CAP., MYLAR, 100V .01uF                |
| 33   | 21-101103   | 1    | CAP., MYLAR, 100V 0.1uF                |
| 34   | 21-101104   | 1    | CAP., MYLAR, 100V 0.1uF                |
| 35   |             |      |  |

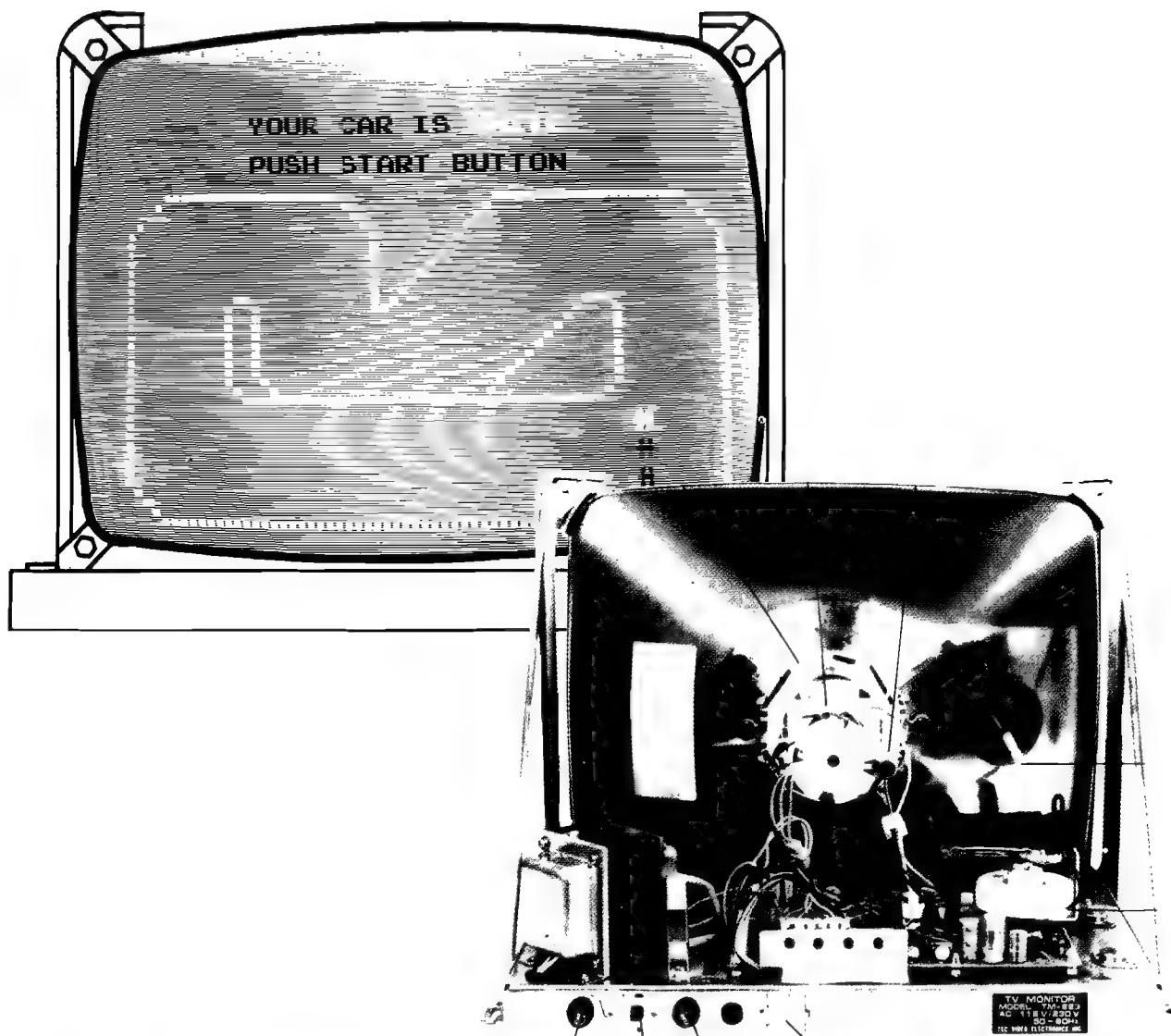
| Item | Part Number | Qty. | Description                  |
|------|-------------|------|------------------------------|
| 36   | 24-250105   | 1    | CAP., ELECTROLYTIC 25V 1uF   |
| 37   | 24-250225   | 1    | " " 2-2uF                    |
| 38   | 24-250106   | 2    | " " 10uF                     |
| 39   | 24-250227   | 1    | CAP., ELECTROLYTIC 25V 220uF |
| 40   |             |      |                              |
| 41   | 27-250103   | 7    | CAP., CER. DISC. 25V .01uF   |
| 42   | 27-250104   | 30   | CAP., CER. DISC. 25V 0.1uF   |
| 43   | 27-250224   | 6    | CAP., CER. DISC. 25V .22uF   |
| 44   | 29-010      | 1    | CAP., TANTALUM 10V 2-2uF     |
| 45   | 29-046      | 1    | CAP., TANTALUM 20V 10uF      |
| 46   | 31-1N914    | 5    | DIODE, 1N914                 |
| 47   | 33-2N3644   | 2    | TRANSISTOR, 2N3644           |
| 48   | 34-2N3565   | 2    | " " 2N3565                   |
| 49   | 34-2N6044   | 1    | " " 2N6044                   |
| 50   | 34-MJE3300  | 1    | TRANSISTOR MJE3300           |
| 51   |             |      |                              |
| 52   | 37-74LS00   | 4    | INTEGRATED CIRCUIT, 74LS00   |
| 53   | 37-74LS02   | 5    | " " 74LS02                   |
| 54   | 37-74LS04   | 4    | " " 74LS04                   |
| 55   | 37-74LS08   | 3    | " " 74LS08                   |
| 56   | 37-74LS10   | 2    | " " 74LS10                   |
| 57   | 37-74LS14   | 2    | " " 74LS14                   |
| 58   | 37-74LS16   | 2    | " " 74LS16                   |
| 59   | 37-74LS27   | 1    | " " 74LS27                   |
| 60   | 37-74LS32   | 1    | " " 74LS32                   |
| 61   | 37-74LS37   | 1    | " " 74LS37                   |
| 62   | 37-74LS42   | 3    | " " 74LS42                   |
| 63   | 37-74LS74   | 8    | " " 74LS74                   |
| 64   |             |      |                              |
| 65   | 37-74LS86   | 6    | " " 74LS86                   |
| 66   | 37-74LS92   | 1    | " " 74LS92                   |
| 67   | 37-74LS93   | 1    | " " 74LS93                   |
| 68   | 37-74LS95   | 1    | " " 74LS95                   |
| 69   | 37-7496     | 1    | " " 7496                     |
| 70   | 37-74LS109  | 3    | " " 74LS109                  |
| 71   | 37-74LS151  | 1    | " " 74LS151                  |
| 72   | 37-74LS153  | 1    | " " 74LS153                  |
| 73   | 37-74LS157  | 8    | " " 74LS157                  |
| 74   | 37-74LS163  | 4    | " " 74LS163                  |
| 75   | 37-74LS164  | 2    | " " 74LS164                  |
| 76   | 37-74LS166  | 1    | " " 74LS166                  |
| 77   | 37-74LS174  | 4    | " " 74LS174                  |
| 78   | 37-74LS175  | 2    | " " 74LS175                  |
| 79   | 37-74LS191  | 8    | " " 74LS191                  |
| 80   | 37-74LS245  | 3    | " " 74LS245                  |
| 81   | 37-74LS251  | 3    | " " 74LS251                  |
| 82   | 37-74LS253  | 1    | " " 74LS253                  |
| 83   | 37-74LS273  | 3    | " " 74LS273                  |
| 84   | 37-74LS367  | 3    | " " 74LS367                  |

**Figure 5-16 Smokey Joe PCB Assembly  
Parts List -02 Version**

| Item | Part Number | Qty. | Description                                      |
|------|-------------|------|--|
| 85   | 37-556      | 1    | TIMER, 556 B9                                    |
| 86   | 37-LM323    | 1    | REGULATOR, LM323                                 |
| 87   | 37-LM324    | 1    | INTEGRATED CIRCUIT, LM324 E9                     |
| 88   | 37-9316     | 1    | INTEGRATED CIRCUIT, 9316 H6                      |
| 89   |             |      |  |
| 90   |             |      |  |
| 91   | 62-001      | 1    | SWITCH, SPST, MOM.                               |
| 92   | 66-114P1T   | 1    | SWITCH, SPST, X4, DIP B3                         |
| 93   | 66-118P1T   | 1    | SWITCH, SPST, X8, DIP E11                        |
| 94   |             |      |  |
| 95   | 72-1608C    | 2    | SCREW, PAN HD. PH, #6-32x $\frac{1}{2}$ LG, CRES |
| 96   | 75-016      | 2    | WASHER, FLAT, #6                                 |
| 97   | 75-056      | 2    | WASHER, LOCK, INT. STAR, #6                      |
| 98   | 75-916C     | 2    | NUT, #6-32, CRES                                 |
| 99   |             |      |  |
| 100  | 78-06001    | 1    | HEATSINK, LM323                                  |
| 101  | 78-16005    | 1    | SILPAD, LM323                                    |
| 102  |             |      |  |
| 103  | 020670-01   | 6    | TERMINAL, TEST POINT TP1-6                       |
| 104  | 030868-01   | 2    | MOUNT, CONNECTOR                                 |
| 105  |             |      |  |
| 106  | 79-42040    | 1    | SOCKET, 40-PIN, MED. INSERTION C7                |
| 107  | 90-102      | 1    | CRYSTAL, 12.096 MHZ Y1                           |
| 108  |             |      |  |
| 109  | 90-6001     | 1    | MICROPROCESSOR C2                                |
| 110  | 90-7019     | 4    | RAM, 2111A-4 N2,P2,H4,J4                         |
| 111  | 009114-01   | 1    | SYNC PROM R4                                     |
| 112  | 032827-01   | 1    | PROM, ALPHA-NUMERICS R3                          |
| 113  | 032828-01   | 1    | ROM, PLAYFIELD F5                                |
| 114  | 032829-01   | 1    | TAIL ROM 1 J5                                    |
| 115  | 032830-01   | 1    | TAIL ROM 2 L5                                    |
| 116  | 032831-01   | 1    | CAB PROM P7                                      |
| 117  |             |      |  |
| 118  | 032815-01   | 1    | PROGRAM PROM 3 MSB J1                            |
| 119  | 032816-01   | 1    | " " 2 " K1                                       |
| 120  | 032817-01   | 1    | " " 1 " L1                                       |
| 121  | 032818-01   | 1    | " " 0 " M1                                       |
| 122  | 032819-01   | 1    | " " 3 LSB J2                                     |
| 123  | 032820-01   | 1    | " " 2 " K2                                       |
| 124  | 032821-01   | 1    | " " 1 " L2                                       |
| 125  | 032822-01   | 1    | " " 0 " M2                                       |
| 126  |             |      |  |
| 127  |             |      |  |
| 128  |             |      |  |
| 129  |             |      |  |



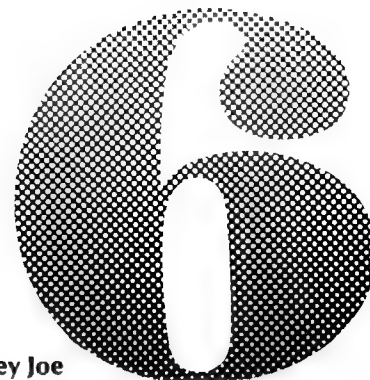




## TV MONITOR SERVICING INFORMATION

This chapter provides servicing information taken from the Motorola and TEC service manuals. Each manual has been reprinted by permission of the respective monitor manufacturer.

Your game will include either the Motorola or TEC monitor, depending on their availability during production.



Smokey Joe



# MOTOROLA

## Service Manual

### CAUTION

No work should be attempted on any exposed monitor chassis by anyone not familiar with servicing procedures and precautions.

### A. GENERAL INFORMATION

This manual contains information on the M5000/M7000 monitor series and the +5 volt logic power supply. The M5000 uses a 19-inch CRT and the M7000 uses a 23-inch CRT. All CRTs are of the magnetic deflection type with integral implosion protection.

All monitor power supplies are capable of producing both +73 and +12 volts regulated from either 115-volt or 230-volt AC input to the transformer primary. All monitor variations described herein require a composite video input signal.

### Note

This service manual refers to the Sky Raider Monitor only

Input and output connections for the monitors are made through a 12-pin connector plug located at the rear of the chassis. Inputs consist of composite video, audio, and 115/220 volt AC three-wire.

All monitors employ: four stages of video amplification, a two-stage sync separator, a two-stage vertical integrator, a four-stage horizontal sweep circuit, a three-stage vertical sweep circuit, a one-stage spot kill, a one stage blanking amplifier; and a regulated, full-wave bridge power supply.

Model Breakdown Chart

| Model     | Video Input | 19" CRT | 23" CRT |
|-----------|-------------|---------|---------|
| M5000-155 | Composite   | X       |         |
| M7000-155 | Composite   |         | X       |

### SAFETY WARNING

#### CAUTION

No work should be attempted on an exposed monitor chassis by anyone not familiar with servicing procedures and precautions.

1. Safety procedures should be developed by habit so that technicians rushed with repair work automatically take precautions.
2. A good practice, when working on any unit, is to first ground the chassis and to use only one hand when testing circuitry. This will avoid the possibility of carelessly putting one hand on chassis or ground and the other on an electrical connection which could cause a severe electrical shock.
3. Extreme care should be used in *handling the picture tube* as rough handling may cause it to implode due to atmospheric pressure (14.7 lbs. per sq. in.). Do not nick or scratch glass or subject it to any undue pressure in removal or installation.

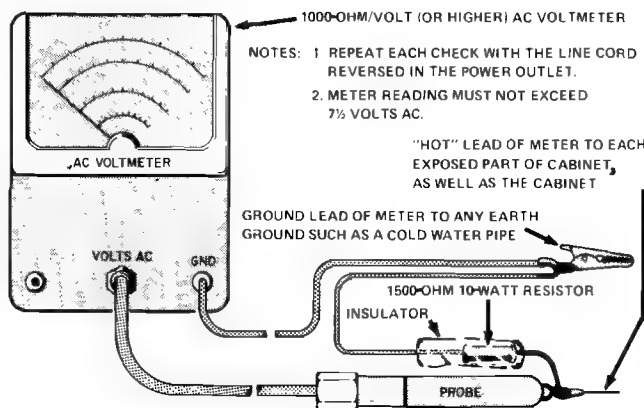
When handling, safety goggles and heavy gloves should be worn for protection. Discharge picture tube by shorting the anode connection to chassis ground (not cabinet or other mounting parts). When discharging, go from ground to anode or use a well-insulated piece of wire. When servicing or repairing the monitor, if the cathode ray tube is replaced by a type of tube other than that specified under the Motorola Part Number as original equipment in this Service Manual, then avoid prolonged exposure at close range to unshielded areas of the cathode ray tube. Possible danger of personal injury from unnecessary exposure to X-ray radiation may result.

4. An *isolation transformer* should always be used during the servicing of a unit whose chassis is connected to one side of the power line. Use a transformer of adequate power rating as this protects the serviceman from accidents resulting in personal injury from electrical shocks. It will also protect the chassis and its components from being



damaged by accidental shorts of the circuitry that may be inadvertently introduced during the service operation.

5. Always *replace protective devices*, such as fishpaper, isolation resistors and capacitors and shields after working on the unit.
6. *Before returning a serviced unit*, the service technician must thoroughly test the unit to be certain that it is completely safe to operate without danger of electrical shock. *Do not use a line isolation transformer when making this test.*



**Voltmeter Hook-up for Safety Check**

In addition to practicing the basic and fundamental electrical safety rules, the following test, which is related to the minimum safety requirements of the Underwriters Laboratories, should be performed by the service technician before any unit which has been serviced is installed in a game again.

A 1000-ohm-per-volt AC voltmeter is prepared by shunting it with a 1500-ohm, 10-watt resistor. The safety test is made by contacting one meter probe to any portion of the unit exposed to the operator such as the cabinet trim, hardware, controls, knobs, etc., while the other probe is held in contact with a good "earth" ground such as a cold water pipe.

The AC voltage indicated by the meter must not exceed 7 1/2 volts. A reading exceeding 7 1/2 volts indicates that a potentially dangerous leakage path exists between the exposed portion of the unit and earth ground. Such a unit represents a potentially serious shock hazard to the operator.

The above test should be repeated with the power plug reversed, when applicable.

*Never reinstall a monitor which does not pass the safety test until the fault has been located and corrected.*

**Table 6-1 Motorola Monitor Electrical Specifications**

|                 | MODEL M5000-155  | MODEL M7000-155  |
|-----------------|--|--|
| PICTURE TUBE    | 19" measured diagonally (48.2 cm); 184 sq. inch viewing area (1188 sq. cm); 114° deflection angle; integral implosion protection; P4 phosphor standard | 23" measured diagonally (58.4 cm); 282 sq. inch viewing area (1820 sq. cm); 110° deflection angle; integral implosion protection; P4 phosphor standard |
| POWER INPUT     | 115/230 VAC, 110 Watts (nominal); 60 Hz provision for 230 VAC, 50 Hz   |  |
| FUSES           | M5000-155, M7000-155—0.8A  |  |
| +73 VOLT SUPPLY | Electronically regulated over AC inputs from 103 VAC to 130 VAC, or 260 VAC to 260 VAC   |  |
| VIDEO INPUT     | 0.5 Volts to 2.5 Volts P/P maximum, composite for 50V at CRT   |  |
| RESOLUTION      | 500 lines at picture center  |  |
| LINEARITY       | Within 3%, measured with standard EIA ball chart and dot pattern   |  |

**Table 6-1 Motorola Monitor Electrical Specifications**

|                              |  |   |
|------------------------------|--|---|
| HIGH VOLTAGE                 | 17KV (nominal)   |   |
| HORIZONTAL BLANKING INTERVAL | 11 microseconds typical (includes retrace and delay)   |   |
| SCANNING FREQUENCY           | Horizontal: 15,750 Hz±500 Hz; Vertical: 50/60 Hz   |   |
| ENVIRONMENT                  | Operating temperature: 10°C to 55°C (ambient)<br>Storage Temperature: -40°C to +65°C<br>Operating Altitude: 10,000 ft. maximum (3048 meters)<br>Designed to comply with applicable DHEW rules on X-Radiation<br>CSA certified for use in coin-operated amusements in a combustible enclosure<br>UL listed under specification 1410 (electronic components) |   |
| TYPICAL DIMENSIONS           | 14.11" H, 18.18" W, 14.83" D<br>(35.8 x 46 x 37.6 cm)  | 16.72" H, 21.56" W, 16.18" D<br>(42.4 x 54.7 x 41 cm) |

*Specifications subject to change without notice.*

## **B. SERVICE NOTES**

### **Circuit Tracing**

Component reference numbers are printed on the top and bottom of the three circuit cards to facilitate circuit tracing. In addition, control names are also shown and referenced on the schematic diagram in this manual.

Transistor elements are identified as follows:  
E—Emitter, B—Base, C—Collector.

### **Component Removal**

Removing components from an etched circuit card is facilitated by the fact that the circuitry (copper foil) appears on one side of the circuit card only and the component leads are inserted straight through the holes and are not bent or crimped.

It is recommended that a solder extracting gun be used to aid in component removal. An iron with a temperature-controlled heating element would be desirable since it would reduce the possibility of damaging the circuit card foil due to over-heating.

The nozzle of the solder extracting gun is inserted directly over the component lead and when sufficiently heated, the solder is drawn away, leaving the lead free from the copper foil. This method is particularly suitable in removing multi-terminal components.

### **CRT Replacement**

Use extreme care in handling the CRT, as rough handling may cause it to implode due to high vacuum pressure. Do not nick or scratch glass or subject it to any undue pressure in removal or installation. Use goggles and heavy gloves for protection. In addition, be sure to disconnect the monitor from all external voltage sources.

1. Discharge CRT by shorting 2nd anode to ground; then remove the CRT socket, deflection yoke and 2nd anode lead.
2. Remove CRT from the front of the chassis by loosening and removing four screws, one in each corner of the CRT.

### **Adjustments**

A non-metallic tool is recommended when performing the following adjustments.

### **Regulator Adjustment**

#### **NOTE**

Misadjustment of the +73 volt regulator or the horizontal oscillator may result in damage to the horizontal output transistor or pulse-limiter diode. The following procedure is recommended to insure reliable operation.

1. Connect the monitor to an AC line supply; then adjust supply to 120 volts (240 volts in some applications).
2. Apply test signal to proper input. Signal should be of same amplitude and sync rate as when monitor is in service.
3. Adjust HOR. SET coil L1 until display is stable.
4. Connect a DC digital voltmeter or equivalent precision voltmeter to the emitter of the regulator output transistor, Q17, or any +73 volt test point.
5. Adjust the 73V ADJUST. control, R93, for an output of +73 volts. *Do not* rotate the control through its entire range; damage to the monitor may result.
6. When adjustment is complete, the AC line supply can be varied between 103 and 130 volts AC to check for proper regulator operation. With the regulator operating properly, changes in display size should be negligible.

#### Horizontal Hold/Oscillator Adjustment

Adjust the core of HOR. SET coil L1 until the horizontal blanking lines are vertical or the CRT display is stable (synced).

#### Vertical Height/Linearity Adjustment

1. Connect a test generator whose output is similar to the display signal normally used.

2. Rotate the vertical size control, R60, until the smallest display is obtained.
3. Adjust the vertical linearity control, R64, until the top and bottom of the test pattern is equally spaced.
4. Readjust R60 until the desired display height is obtained.
5. Readjust R64, if necessary, as in Step 2 above.

#### Focus Adjustment

The best overall focus of the display is obtained by adjusting the focus control, R42, for best focus at a point which is near the center and approximately 1/3 down from the top of the display.

#### Monitor Servicing

The monitor circuit board may be installed in a service position to provide easier access to the circuit foil when servicing the monitor (see Figure 6-1).

### C. THEORY OF OPERATION

#### Power Supply

The power supplies are transformer-operated, full-wave, regulated supplies which maintain constant output voltages for input line variations of 103 volts AC to 130 volts AC, or 206 volts AC to 260 volts AC. Regulation of the output voltages is accomplished by using positive feedback through the integrated circuit reference amplifier.

#### +73 Volt Supply (See Figures 6-3, 6-4)

When the +73 volt supply attempts to increase, the voltage at pin 3 of IC1 will increase, while the voltage at pin 2 remains constant due to D20. The increasing voltage at pin 3 will cause the output voltage of the reference amplifier (pin 6) to increase the forward bias of Q19. The collector voltage of Q19, forward bias of Q18, and the base current of Q17 will all decrease. The resultant proportional increase of Q17 collector-to-emitter voltage will cancel the attempted output voltage increase.

When the +73 volt supply bus attempts to decrease; the voltage at pin 3 of IC1 will decrease while the voltage at pin 2 remains constant. The decreasing voltage at pin 3 will cause the reference amplifier output voltage at pin 6 to decrease the forward bias of Q19. The collector voltage of Q19, the forward bias of Q18 and the base current of Q17 will increase. The collector-to-emitter voltage of Q17, which is in series

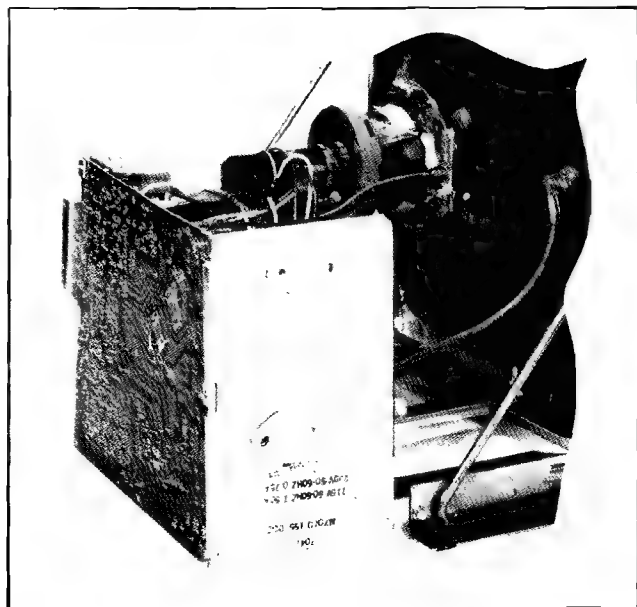


Figure 6-1 Motorola Monitor Circuit Board in Service Position

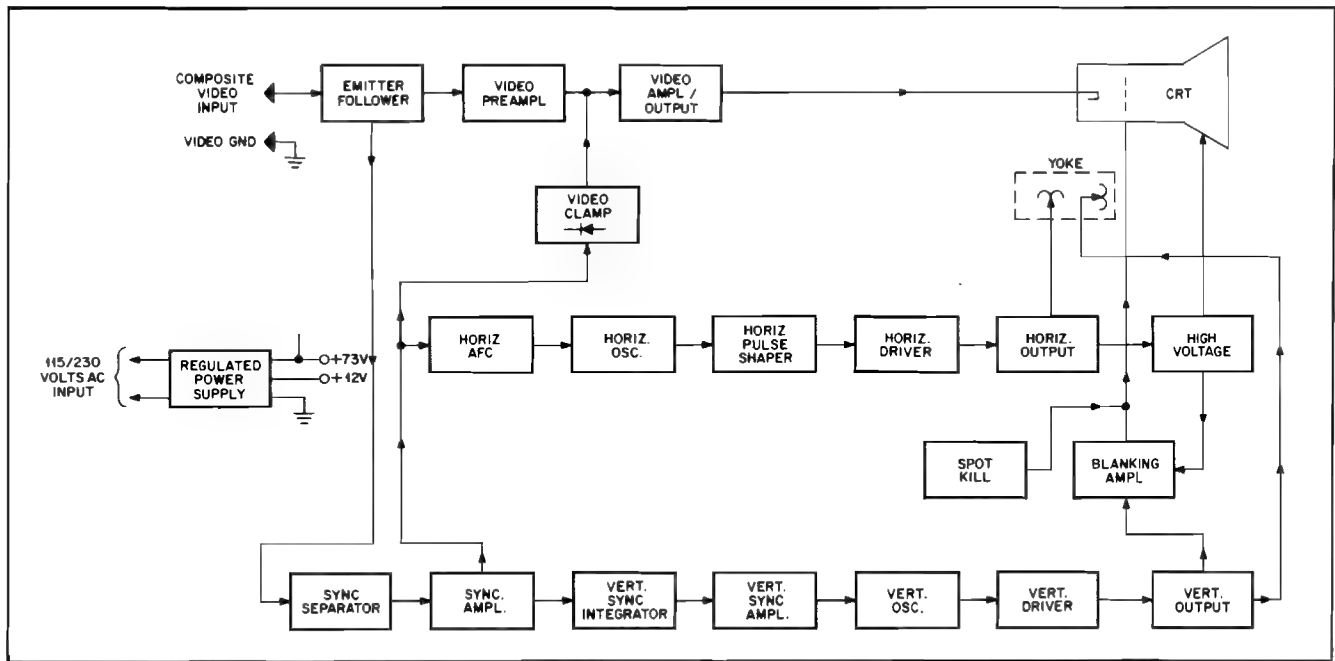


Figure 6-2 Motorola Monitor Block Diagram

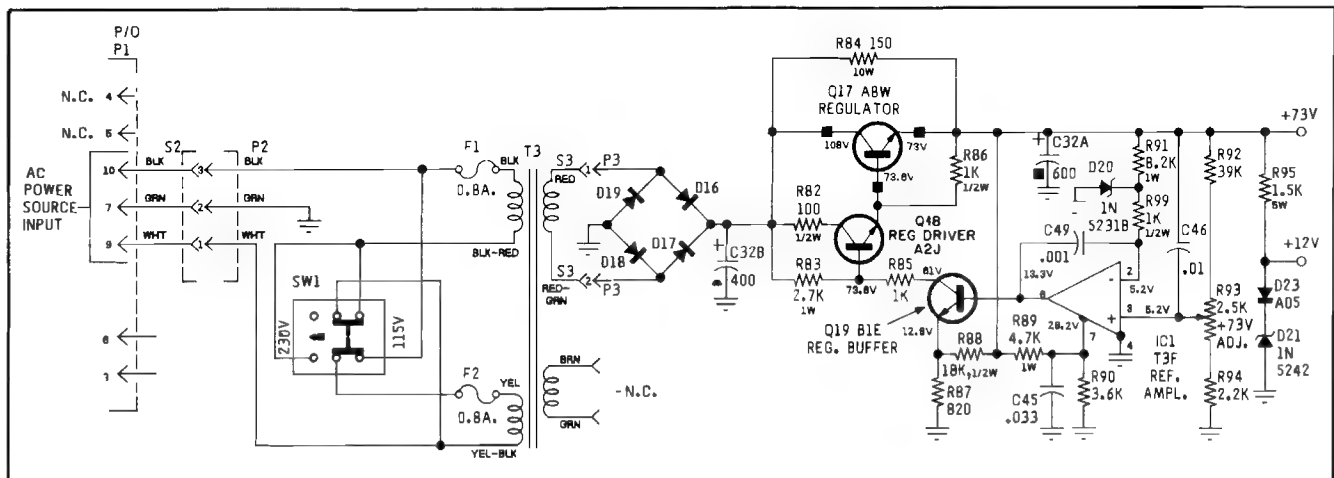


Figure 6-3 +73 Volt Supply Circuit

with the output, will decrease proportionally to the attempted decrease in the output bus.

Resistor R84 shunts a portion of the output current around Q17 so less power is dissipated within the device. Resistor R82 is the current-limiting resistor for Q18, and R86 controls the leakage current of Q17. Resistors R83 and R85 are the collector load for Q19, and R88 and R87 provide an emitter voltage for Q19 within the range of IC1's output voltage variations. Capacitor C45 filters high frequency variations from the voltage at pin 7 of IC1, and C49 is a Miller-effect capacitor which eliminates instability.

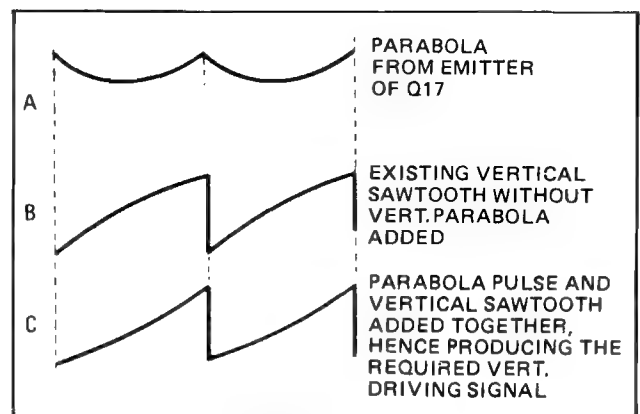
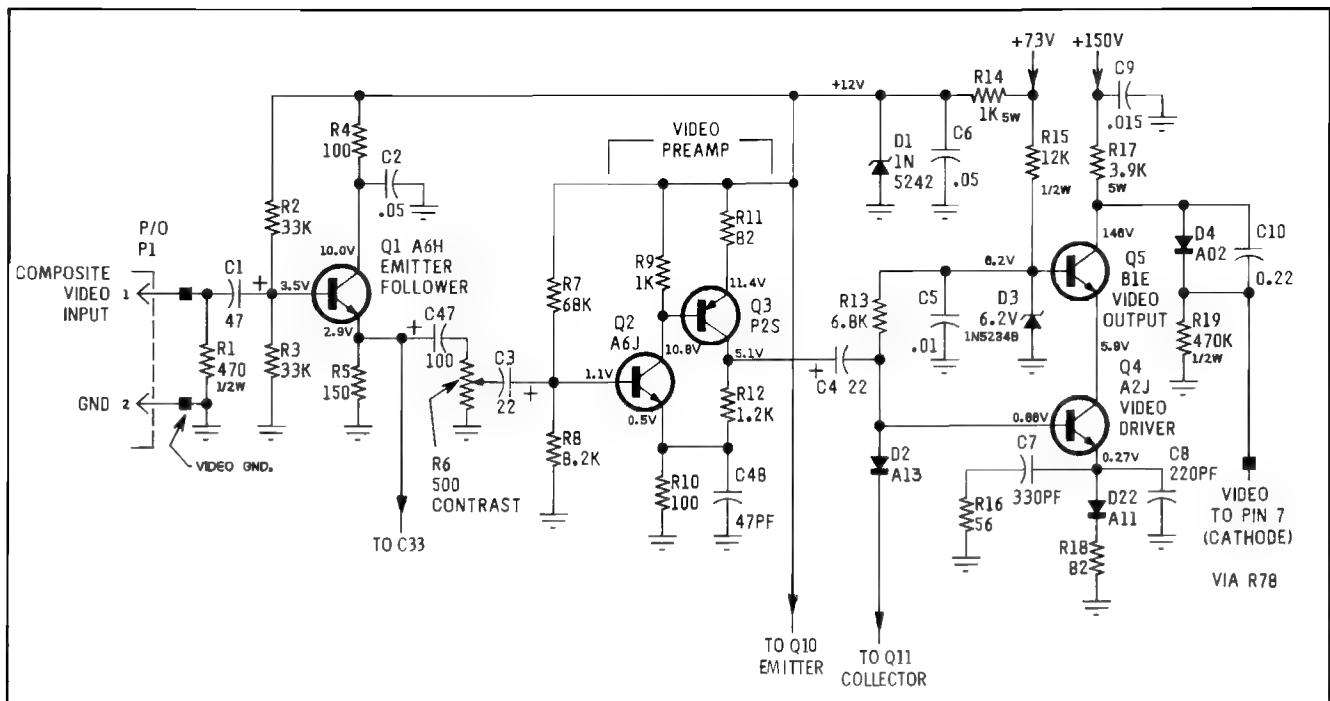


Figure 6-4 Motorola Monitor Vertical Drive Waveform



**Figure 6-5 Motorola Monitor Video Amplifiers and Output Circuit**

Capacitor C32A filters horizontal frequency variations from the output bus.

Resistor R91 provides bias current for D20, and the value of R99 presents an impedance from pin 2 of IC1 to AC ground (through D20). Capacitor C46 couples high frequency voltage variations, which occur at the output bus, back to pin 3—preventing oscillations for proper operation of the reference amplifier. Resistors R92, R93, and R94 provide voltage division such that the adjustment of R93 can be set equal to the voltage of pin 2 of IC1. Resistor R95 provides bias current for D21 and also provides the +12 volt output. Diode D23 is necessary to temperature-compensate for variations within D21. Capacitor C32B filters AC variations from the output of the full-wave bridge.

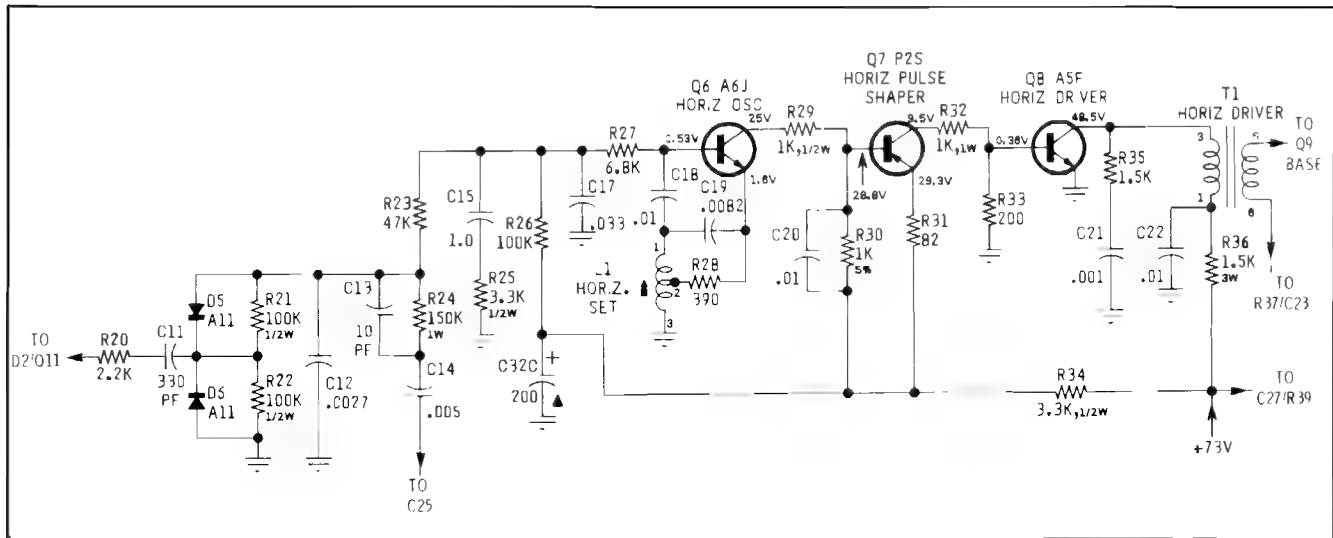
#### Video Amplifiers and Output (See Figure 6-5)

The composite video signal is coupled to the emitter-follower Q1 through the input connector P1 and capacitor C1. Transistor Q1 is a buffer stage which matches the impedance of the signal source to the video preamplifier and the sync separator stages. Resistor R1 is a terminating resistor for the video signal source, and resistors R2, R3, R4, and R5 form the biasing network for the stage. Capacitor C2 bypasses higher video frequencies to ground. The

composite video signal is coupled from the emitter of Q1 to the sync separator Q10 through C33 and to the contrast control R6 through C47.

The contrast control varies the amplitude and couples the composite video signal to the base of Q2 through capacitor C3. Transistors Q2 and Q3 are complimentary, direct-coupled, common emitter amplifiers. The voltage gain (approximately 12) of the preamplifier stage is controlled by the feedback arrangement of R9, R10, R11, and R12. Resistors R7 and R8 provide the base bias voltage for Q2. Capacitor C48 is used for high-frequency peaking.

The output of the video preamplifier stage is coupled to the video output stage through capacitor C4. Diode D2 clamps the video signal to approximately +0.7 volts (DC restoration) when a sync pulse turns on the sync amplifier Q11. The video output stage is connected in a cascade configuration. Transistor Q4 is a common emitter amplifier and Q5 is connected in a common base arrangement. Capacitors C7, C8, and resistor R16 are used for high-frequency compensation, and resistor R18 controls the gain of the stage to approximately 47. Diode D3 maintains the base of Q5 at +6.2 volts, while capacitor C5 filters the video signal variations from the base voltage. Resistor R13 provides a DC bias path for D2, and R19 and D4 are used to limit the current through the CRT.



**Figure 6-6 Motorola Monitor Horizontal Deflection Circuit**

Capacitor C10 AC-couples the video from the collector of Q5 to the cathode of the CRT if D4 turns off due to high beam currents. Resistor R17 is the collector load for Q5, and R15 provides the bias current for the zener diode D3. Capacitors C9 and C6 filter video frequencies from the +150 volt and +12 volt supplies. Resistor R14 and zener diode D1 are used to supply +12 volts for Q1, Q2, and Q3.

## D. HORIZONTAL DEFLECTION CIRCUITS (See Figure 6-6)

### Phase Detector (See Figure 6-7)

The phase detector consists of two diodes (D5 and D6) in a keyed clamp circuit. Two inputs are required to generate the required output, one from the horizontal sync amplifier, Q11, and one from the horizontal output circuit, Q9. The required output must be of the proper polarity and amplitude to correct phase differences between the input horizontal sync pulses and the horizontal time base.

The horizontal output (Q9) collector pulse is integrated into a sawtooth by R24 and C12. During horizontal sync time, diodes D5 and D6 conduct, which shorts C12 to ground. This effectively clamps the sawtooth on C12 to ground at sync time. If the horizontal time base is in phase with the sync (waveform A), the sync pulse will occur when the sawtooth is passing through its AC axis, and the net charge on C12 will be zero (waveform B). If the horizontal time base is lagging the sync, the sawtooth on C12 will be clamped to ground at a point negative from the AC axis. This will result in a positive DC charge on C12 (waveform C). The positive polarity

causes the horizontal oscillator to speed up and correct the phase lag. Likewise, if the horizontal time base is leading the sync, the sawtooth on C12 will be clamped at a point positive from its AC axis. This results in a net negative charge on C12 which is the required polarity to slow the horizontal oscillator (waveform D).

Components R23, C15, R25 and C17 comprise the phase detector filter. The bandpass of this filter is chosen to provide correction of horizontal oscillator phase without ringing or hunting. Capacitor C13 times the phase detector for correct centering of the picture on the raster.

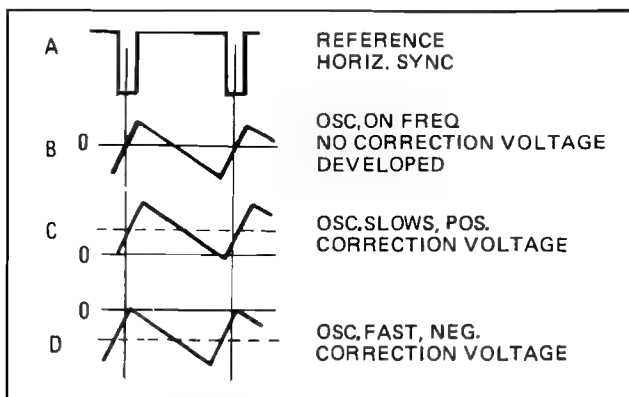
### Horizontal Oscillator

The horizontal oscillator employs the principles of the Hartley-type oscillator. Its operating frequency is sensitive to its DC base input voltage, thus permitting the frequency of the oscillator to be varied by the output voltage of the phase detector. The main frequency-determining components are L1, C19, and R28. The oscillator operates as a switch being biased alternately into saturation and cut-off. The initial forward starting bias is supplied via R26.

### Horizontal Pulse Shaper and Driver

The horizontal pulse shaper Q7 serves as a buffer stage between the horizontal oscillator and driver. Capacitor C20 and resistor R30 combine to shape the input waveform to the required duty cycle of 50%, which is necessary to drive the horizontal output stage.





**Figure 6-7 Motorola Monitor Horizontal Deflection Waveforms**

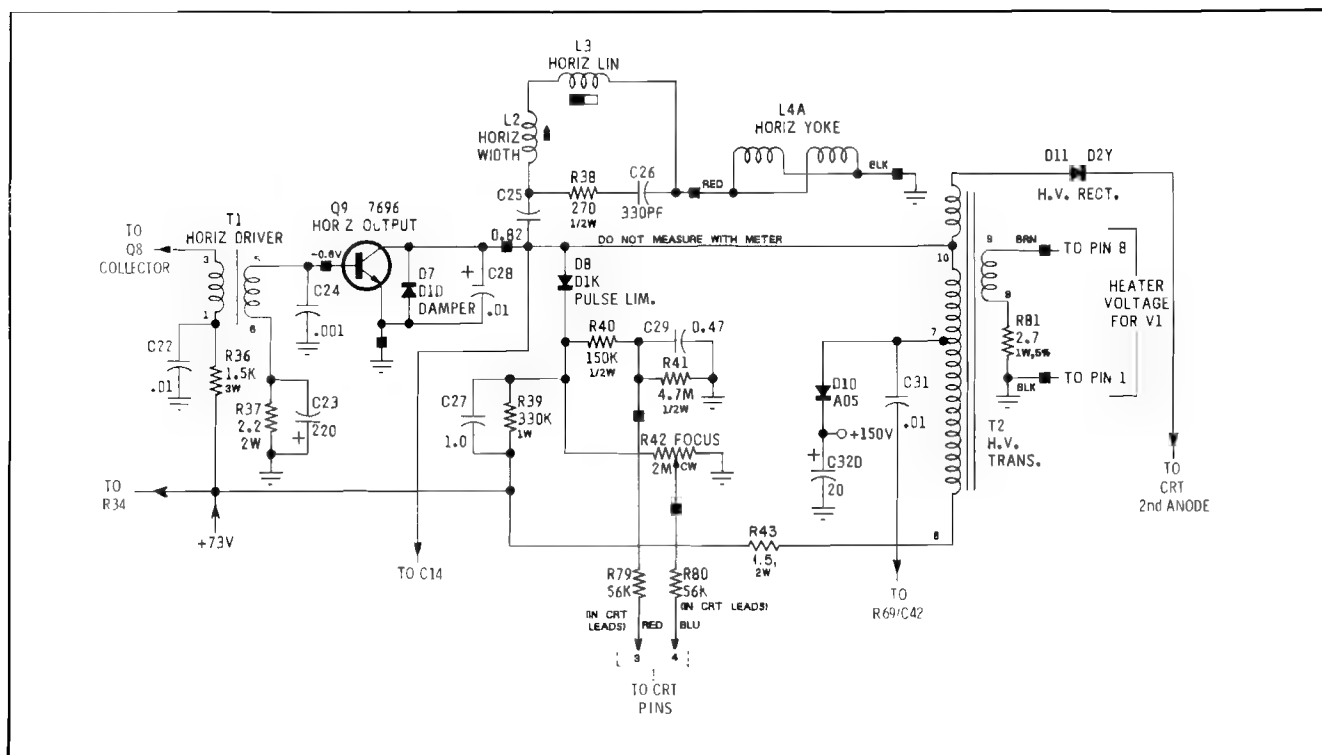
The horizontal driver Q8 operates as a switch to driving horizontal output transistor Q9 through T1. Because of the low impedance drive and fast switching times, very little power is dissipated in Q8.

Resistor R35 and capacitor C21 provide damping to suppress ringing in the primary of T1 when Q8 goes into cut-off. Resistor R36 is used for limiting current in the collector of Q8, and C22 filters the horizontal frequency variations from the DC side of the transformer primary.

## Horizontal Output (See Figure 6-8)

The secondary of T1 provides the required low drive impedance for Q9. Resistor R37 limits current in the base of Q9, while capacitor C23 provides additional reverse bias to keep Q9 turned off during the horizontal retrace pulse. Transistor Q9 operates as a switch which once each horizontal time period connects the supply voltage across the parallel combination of the horizontal deflection yoke and the primary of T2. The required sawtooth deflection current through the horizontal yoke is formed by the L-R time constant of the yoke and output transformer primary. The horizontal retrace pulse charges C27 through D8 to provide operating voltage for G2 of the CRT. Momentary transients at the collector of Q9, should they occur, are limited to the voltage on C27, since D8 will conduct if the collector voltage exceeds this value.

The damper diode D7 conducts during the period between retrace and turn-on of Q9 to reduce retrace overshoot; capacitor C28 is the retrace tuning capacitor. Capacitor C25 blocks DC from deflection yoke. Components R38 and C26 are damping components for the width and linearity coils. Capacitor C32D is charged through D10, developing the video output supply voltage.



**Figure 6-8 Motorola Monitor Horizontal Output Circuit**

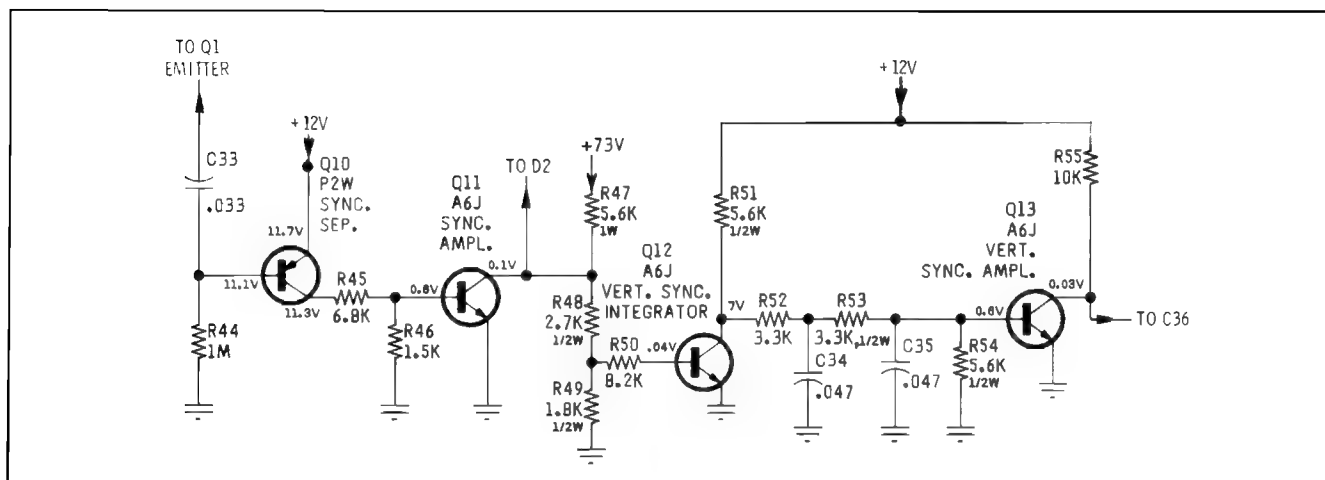


Figure 6-9 Motorola Monitor Sync Circuit

### Sync Circuits (See Figure 6-9)

The video signal is coupled from the emitter of Q1 to the base of Q10 through C33. The negative-going sync tips turn on Q10 and are clamped to the value of the base voltage due to the base-emitter diode junction. The video information within the composite video signal, however, is less negative and Q10 remains off between each sync tip. Therefore, the waveform at the collector of Q10 will contain only the composite sync pulse information.

Resistors R45 and R46 provide base bias for Q11. The composite sync pulses are amplified and inverted by Q11 where they are coupled to the vertical sync

integrator Q12, the horizontal phase detector, and the video clamp diode D2. Resistors R47, R48, and R49, are the collector load for Q11, and also provide base bias for Q12. Resistor R50 limits current through the base-emitter junction of Q12, and R51 is its collector load. Components R52, C34, R53, C35, and R54 form a double integrator which removes the horizontal pulses from the composite sync signal, leaving the vertical pulses to be amplified by Q13 and coupled to the vertical oscillator.

### Vertical Oscillator and Output (See Figure 6-10)

The vertical oscillator is a relaxation oscillator and operates at a free-running frequency that is set by

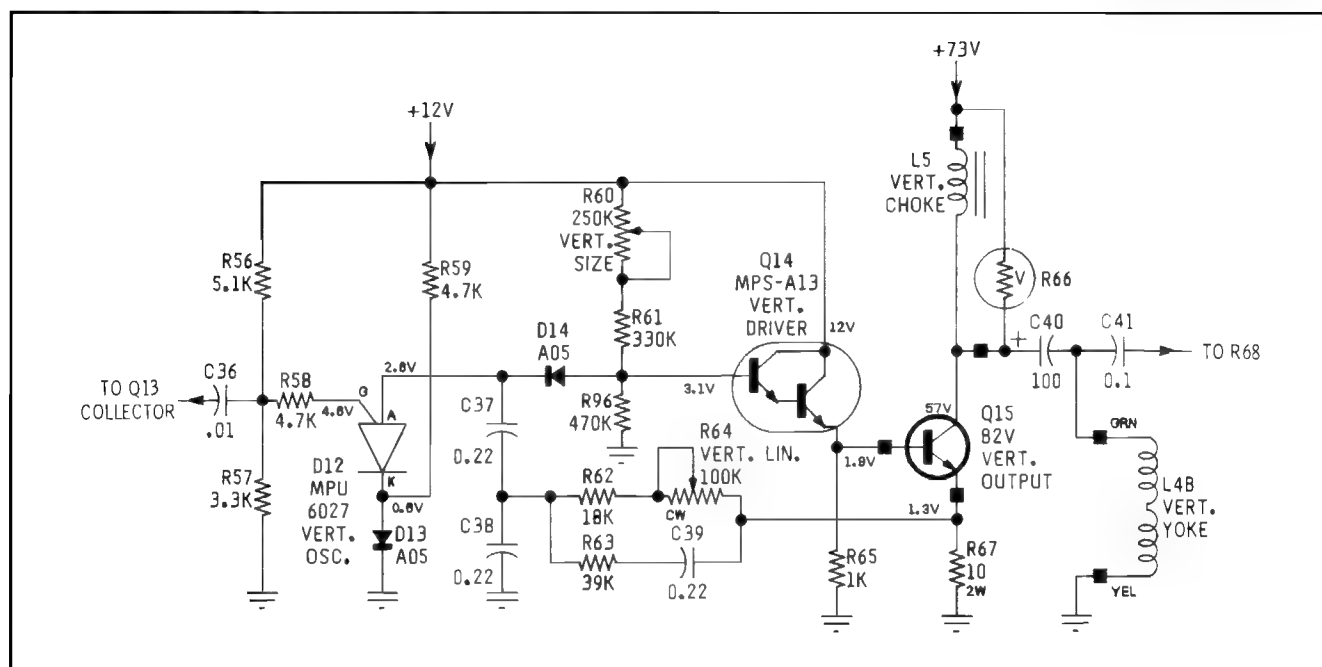


Figure 6-10 Motorola Monitor Vertical Oscillator Circuit

the value of resistors R56 and R57. The series combination of C37 and C38 charges through D14, R61, and R60, until D12 turns on. This occurs when the anode voltage of D12 exceeds the gate voltage by approximately 1.0 volt. When D12 conducts, C37 and C38 are discharged to nearly zero volts; then D12 turns off and the cycle repeats. The value of R61 and the setting of R60 determines the amplitude of the waveform.

Diode D14 provides a small incremental voltage above ground to overcome the forward base-emitter drop of Q14; D13 provides temperature compensation for the output stage. Resistor R96 provides a constant oscillator load for variations in input impedance of Q14. Transistor Q14 is an emitter-follower used to transform the high impedance drive sawtooth to a low impedance drive for Q15.

The vertical choke L5 acts as a current source during linear scan time and provides a high-voltage pulse to aid retrace when Q15 shuts off. To limit this pulse to a safe value, a varistor, R66, is connected across the choke.

Since the impedance of the choke decreases when the collector current of Q15 increases, severe vertical non-linearity will result unless some compensation is employed.

Resistors R64 and R62 couple the emitter voltage of Q15 to the junction of C37 and C38. This path is resistive, and the waveform coupled back will be integrated by C38. This results in a pre-distortion of the drive sawtooth. This is done to compensate for the non-linear charging of C37, C38 and the changing impedance of C5. An additional feedback path through R63 and C39 serves to optimize the drive waveshape for best linearity. Capacitor C40 couples the signal to the vertical yoke winding and blocks DC.

### Spot Kill (See Figure 6-11)

The spot kill circuitry is used to reduce the effect of the electron beam concentrating on one area of the CRT after the monitor is turned off. The circuitry is accomplished by raising the arm of potentiometer R73 to the +150 volt level and, therefore, increasing the brightness to maximum to dissipate the high-voltage charge that normally remains in the CRT.

When the monitor is operating, transistor Q20 is on and its collector is near zero volts. Capacitor C44 charges through the base-emitter junction of Q20 and R97. Resistor R72 provides the base bias voltage required to keep Q20 on. When the monitor is turned

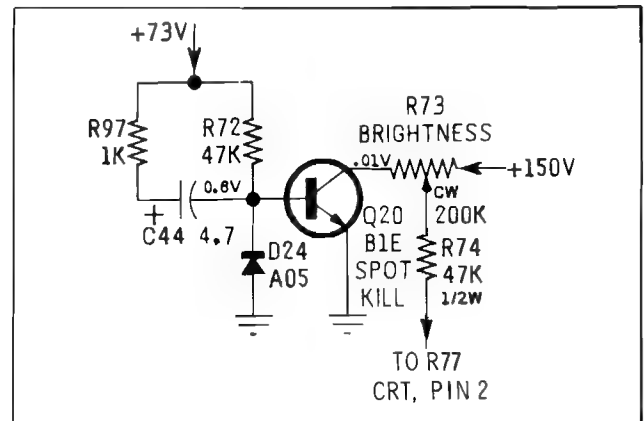


Figure 6-11 Motorola Monitor Spot Killer Circuit

off, the falling +73 volts is coupled to the base of Q20 to turn off the transistor causing its collector voltage to rise to approximately +150 volts. Diode D24 prevents the negative voltage swing at the base of Q20 from exceeding the reverse voltage rating of the transistor.

### Blanking Amplifier (see Figure 6-12)

The blanking amplifier combines both the vertical and horizontal retrace pulses to turn off the electron beam in the CRT once every horizontal line and once every vertical field.

Capacitor C41 couples the vertical retrace pulses and capacitor C31 couples the horizontal retrace pulses to the blanking amplifier. Resistor R68 determines the amplitude of the vertical pulses, while R69 determines the amplitude of the horizontal pulses. Capacitor C42 bypasses R69 to couple the leading and trailing edges of the horizontal retrace pulses to the amplifier. Resistor R70 allows C41 to discharge when the retrace pulses swing below zero volts. Diode D15 prevents the retrace overshoot from exceeding the reverse voltage rating of Q20. Resistor R71 permits Q20 to turn off between retrace pulses, while R75 and R76 provide the collector voltage for Q20. Capacitor C43 couples the blanking pulses to the control grid of the CRT.

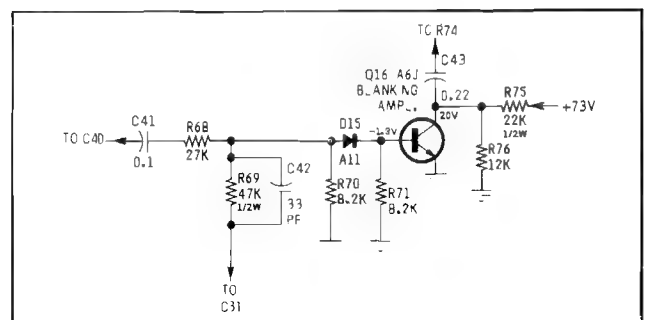


Figure 6-12 Motorola Monitor Blanking Amplifier Circuit

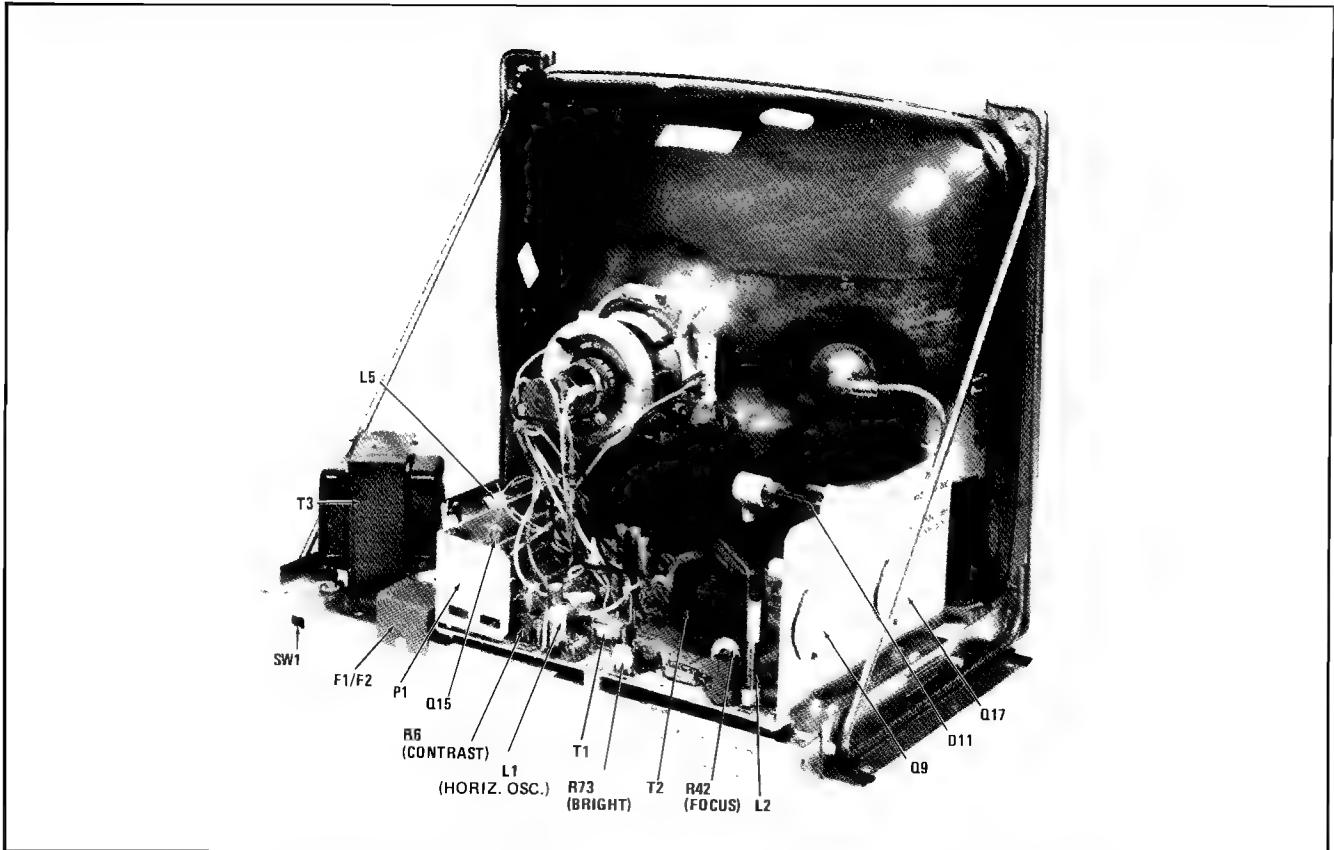


Figure 6-13 Motorola Monitor Chassis Rear View —Component Location

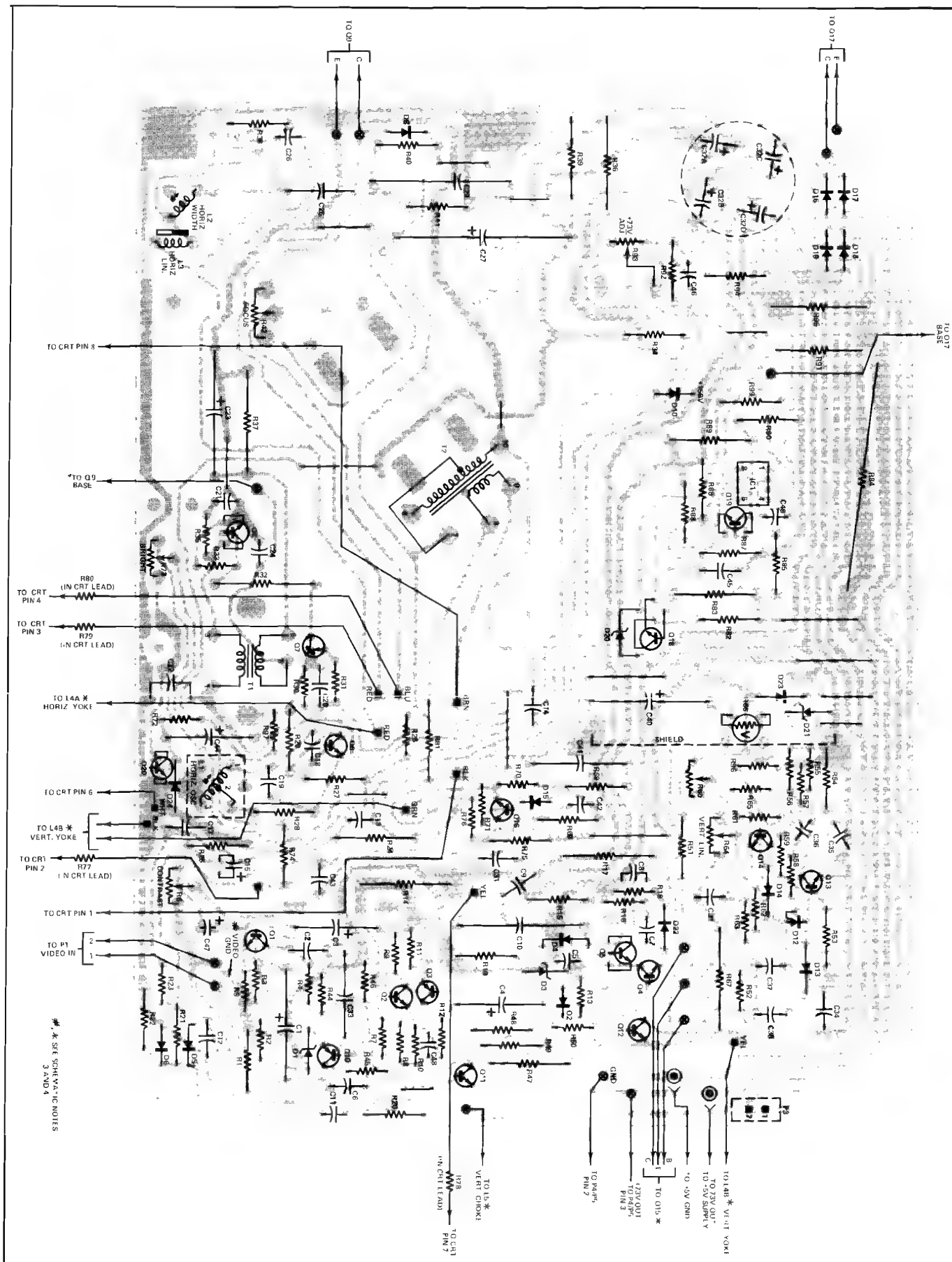
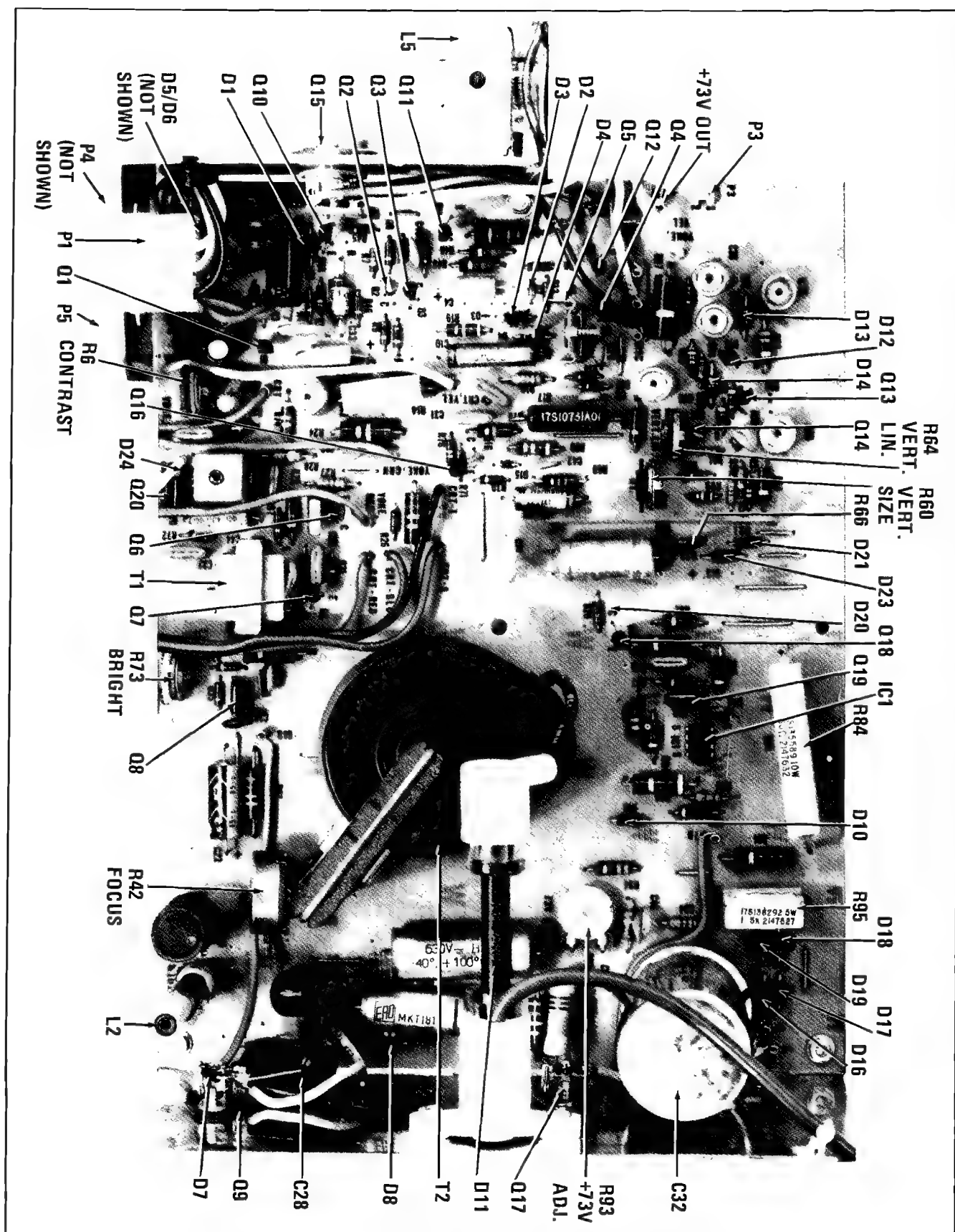


Figure 6-14 Motorola Monitor Circuit Board Detail—Solder View

**Figure 6-15 Motorola Monitor Schematic Diagram**



**Table 6-2 Motorola Replacement Part Numbers**

| REF.<br>NO.   | PART<br>NUMBER | DESCRIPTION                          | REF.<br>NO.           | PART<br>NUMBER | DESCRIPTION                                |
|---|----------------|--------------------------------------|-----------------------|----------------|--|
| <b>Capacitors:</b><br>All values are in Microfarads unless otherwise noted. |                |                                      | C31                   | 8S10191B98     | .01, 10%, 250V; Poly.                      |
| C1  | 23S10255A27    | 47, 50V; Lytic                       | C32                   | 23S10255B73    | 20/200, 400/125, 600/100,<br>200/50; Lytic |
| C2  | 21S135660      | .05, +80–20, Z5V, 50V;<br>Cer. Disc. | C33                   | 8S10191A51     | .033, 10%, 160V; Poly.                     |
| C3, C4  | 23S187A26      | 22, 25V; Lytic                       | C34, C35              | 8S10191A32     | .047, 10%, 250V; Poly.                     |
| C5  | 21S180E60      | .01, +80–20; Z5V, 50V;<br>Cer. Disc. | C36                   | 21S180E60      | .01, +80–20, Z5V, 50V;<br>Cer. Disc.       |
| C6  | 21S135660      | .05, +80–20, Z5V, 50V;<br>Cer. Disc. | C37, 38, 39           | 8S10191B67     | 0.22, 10%, 250V; Poly.                     |
| C7  | 21S131625      | 330pf, 10%, X5F, 500V;<br>Cer. Disc. | C40                   | 23S10255A60    | 100, 63V; Lytic                            |
| C8  | 21S180B87      | 220pf, 10%, X5F, 500V;<br>Cer. Disc. | C41                   | 8S10212B16     | 0.1, 20%, 400V; Mtlz.<br>Poly.             |
| C9  | 8S10191B99     | .015, 10%, 250V; Poly.               | C42                   | 21S180C82      | 0.33, 10%, N150, 500V;<br>Cer. Disc.       |
| C10   | 8S10212B18     | 0.22, 10%, 400V;<br>Mtlz. Poly.      | C43                   | 8S10191B67     | 0.22, 10%, 250V; Poly.                     |
| C11   | 21S131625      | 330pf, 10%, X5F, 500V;<br>Cer. Disc. | C44                   | 23S10255B28    | 4.7, 100V; Lytic                           |
| C12   | 21S180C41      | .0027, 10%, Z5F, 500V;<br>Cer. Disc. | C45                   | 8S10191B90     | .033, 10%, 250V; Poly.                     |
| C13   | 21S180C02      | 10pf, 10%, N150, 500V;<br>Cer. Disc. | C46                   | 21S132492      | .01, +80–20, Z5V, 100V;<br>Cer. Disc.      |
| C14   | 21S180D34      | .005, 20%, Z5F, 1KV;<br>Cer. Disc.   | C47                   | 23S10255B63    | 100, 10V; Lytic                            |
| C15   | 23S10229A32    | 1.0, 16V; Lytic                      | C48                   | 21S180D56      | 47pf, 10%, N750, 100V;<br>Cer. Disc.       |
| C17   | 8S10191B90     | .033, 10%, 250V; Poly.               | C49                   | 21S180B51      | .001, 10%, X5F, 500V;<br>Cer. Disc.        |
| C18   | 8S10299B28     | .01, 10%, 100V; Polycarb.            | <b>Diodes:</b>        |                |  |
| C19   | 8S10299B29     | .0082, 10%, 100V;<br>Polycarb.       | D1                    | 48S10813A03    | Diode, Silicon, Zener;<br>1N5242           |
| C20   | 8S10191B98     | .01, 10%, 250V; Poly.                | D2                    | 48D67120A13    | Diode; A13                                 |
| C21   | 21S180B51      | .001, 10%, X5F, 500V;<br>Cer. Disc.  | D3                    | 48S10813A01    | Diode, Silicon, Zener;<br>1N5234B          |
| C22   | 8S10191B98     | .01, 10%, 250V; Poly.                | D4                    | 48S191A02      | Rectifier, Silicon; 91A02                  |
| C23   | 23S10255B50    | 150, 10V; Lytic                      | D5, D6                | 48D67120A11    | Diode; A11                                 |
| C24   | 21S180B51      | .001, 10%, X5F, 500V;<br>Cer. Disc.  | D7                    | 48S134921      | Diode, Damper; D1D                         |
| C25   | 8S10299B27     | 0.82, 10%, 200V; Mtlz.<br>Polycarb.  | D8                    | 48S134978      | Diode, Pulse Lim; D1K                      |
| C26   | 21S131625      | 330pf, 10%, X5F, 500V;<br>Cer. Disc. | D10                   | 48S191A05      | Rectifier, Silicon; 91A05                  |
| C27   | 8S10212A11     | 1.0, 10%, 630V; Mtlz.<br>Poly.       | D11                   | 48S137114      | Rectifier, H.V., D2Y                       |
| C28   | 8S10571A06     | .01, 5%, 1200V;<br>Polyprop. Foil    | D12                   | 48S137638      | Vert. Osc.; MPU6027                        |
| C29   | 8S10212B53     | 0.47, 10%, 630V; Mtlz.<br>Poly.      | D13, D14              | 48S191A05      | Rectifier, Silicon; 91A05                  |
|   |                |                                      | D15                   | 48D67120A11    | Diode; A11                                 |
|   |                |                                      | D16, D17,<br>D18, D19 | 48S191A05      | Rectifier, Silicon; 91A05                  |
|   |                |                                      | D20                   | 48S10813A02    | Diode, Silicon, Zener;<br>1N5231B          |
|   |                |                                      | D21                   | 48S10813A03    | Diode, Silicon, Zener;<br>1N5242           |
|   |                |                                      | D22                   | 48D67120A11    | Diode; A11                                 |
|   |                |                                      | D23, D24              | 48S191A05      | Rectifier, Silicon; 91A05                  |



**Table 6-2 Motorola Replacement Part Numbers**

| Ref. No.  | Part No.    | Description                        | Ref. No.                       | Part No.    | Description  |
|---|-------------|------------------------------------|--------------------------------|-------------|--|
| <b>Fuses:</b>   |             |                                    | R60                            | 18D25245A29 | Vert. Size; 250K   |
| F1, F2  | 65S138269   | Fuse, 0.8A–250V                    | R64                            | 18D25245A31 | Vert. Lin.; 100K   |
| <b>Integrated Circuits:</b>   |             |                                    | R66                            | 6S10201A04  | Varistor, 1 ma, 120V, 0.5W   |
| IC1   | 51S10732A01 | Ref. Ampl.; T3F                    | R73                            | 18D25245A28 | Control, Brightness; 200K  |
| <b>Coils/Chokes:</b>  |             |                                    | R84                            | 17S135589   | 150, 10%, 10W  |
| L1  | 24C25448A01 | Coil, Horiz. Osc.                  | R93                            | 18D25245A21 | Control, +73V out Adj.; 2.5K                                       |
| L2  | 24D25603A09 | Coil, Horiz. Width                 | R95                            | 10731A03    | 1.5K, 10%, 5W  |
| L3  | 24D25248A14 | Coil, Horiz. Lin.                  | <b>Switches:</b>               |             |  |
| L4  | 24D25261A09 | Coil, Defl. (M5000-155, M5010-155) | SW1                            | 40S10624A07 | Switch, Slide; D.P. D.T.   |
| L4  | 24D25261A10 | Coil, Defl. (M7000-155, M7010-155) | <b>Transformers:</b>           |             |  |
| L5  | 25D25221C12 | Choke, Vertical                    | T1                             | 25D25221A05 | Horiz. Driver  |
| <b>Transistors:</b>   |             |                                    | T2                             | 24D25240B23 | H.V. Transformer   |
| Q1  | 48S137171   | Emitter Follower; A6H              | T3                             | 25D25239B20 | Transformer, Power (M5010-155, M7010-155)                          |
| Q2  | 48S137172   | Video Pre-Ampl.; A6J               | T3                             | 25D25239B30 | Transformer, Power (M5000-155, M7000-155)                          |
| Q3  | 48S137127   | Video Pre-Ampl.; P2S               | <b>Misc. Electrical Parts:</b> |             |  |
| Q4  | 48S134952   | Video Driver; A2J                  | V1                             | 96S241A01   | 19"–CRT; Type 19VARP4 (M5000/M5010)                                |
| Q5  | 48S137476   | Video Output; B1E                  | V1                             | 96S10848A01 | 23"–CRT; Type M22VATP4 (M7000/M7010)                               |
| Q6  | 48S137172   | Horiz. Osc.; A6J                   | <b>Mechanical Parts:</b>       |             |  |
| Q7  | 48S137127   | Horiz. Pulse Shaper; P2S           |                                | 9B25456A01  | Block, Fuse (F1, 2)  |
| Q8  | 48S137093   | Horiz. Driver; A5F                 |                                | 42D25158C01 | Clamp, Defl. Coil  |
| Q9  | 48S137570   | Horiz. Output; B2L                 |                                | 26S10251A08 | Heat Sink (Q5)   |
| Q10   | 48S137173   | Sync Separator; P2W                | P1                             | 15S10183A69 | Housing, Connector; Female (12-Contact, Less Contacts)             |
| Q11   | 48S137172   | Sync Ampl.; A6J                    |                                | 39S10184A67 | Contact, Plug; 5 Req'd M5000/M7000, 9 Req'd; M5010/M7010           |
| Q12   | 48S137172   | Vert. Sync Integrator; A6J         | P2                             | 15S10183A82 | Housing, Connector; Male (3-Contact, Less Contacts), M5000/M7000   |
| Q13   | 48S137172   | Vert. Sync Ampl.; A6J              | P2                             | 15S10183A81 | Housing, Connector; Female (3-Contact, Less Contacts), M5010/M7010 |
| Q14   | 48S137639   | Vert. Driver; MPS A13              |                                | 39S10184A67 | Contact, Plug; 3 Req'd for P2                                      |
| Q15   | 48S137596   | Vert. Output; B2V                  | P3                             | 28S10586A35 | Header, Connector; 2-Contact                                       |
| Q16   | 48S137172   | Blanking Ampl.; A6J                |                                |             |  |
| Q17   | 48S137368   | Regulator; A8W                     |                                |             |  |
| Q18   | 48S134952   | Reg. Driver; A2J                   |                                |             |  |
| Q19   | 48S137476   | Reg. Buffer; B1E                   |                                |             |  |
| Q20   | 48S137476   | Spot Kill; B1E                     |                                |             |  |
| <b>Resistors/Controls:</b>  |             |                                    |                                |             |  |
| NOTE: Only power or special resistors are listed. Use the description when ordering standard values of fixed resistors up to 2 watts. |             |                                    |                                |             |  |
| R6  | 18D25245A27 | Control, Contrast; 500             |                                |             |  |
| R14   | 17S135204   | 100, 10%, 5W                       |                                |             |  |
| R17   | 17S10731A01 | 3.9K, 5%, 5W                       |                                |             |  |
| R36   | 17S10130B07 | 1.5K, 10%, 3W                      |                                |             |  |
| R42   | 18D25218A14 | Control, Focus; 2M                 |                                |             |  |

**Table 6-2 Motorola Replacement Part Numbers**

| REF. NO. | PART NUMBER | DESCRIPTION  | REF. NO. | PART NUMBER | DESCRIPTION   |
|----------|-------------|--|----------|-------------|---|
| P4, P5   | 15S10183B12 | Housing, Connector; Female (3-Contact, Less Contacts) M5010/M7010  |          | 14B25459A01 | Insulator, Fuse Cover (F1, 2)                                 |
|          | 39S10184A84 | Contact, Plug; 3 ea. Req'd for P5, M5010/M7010                     |          | 14A562353   | Insulator, Mica (Q9, Q15, Q17)                                |
| S2       | 15S10183A81 | Housing, Connector; Female (3-Contact, Less Contacts), M5000/M7000 |          | 14C25230A01 | Insulator, Molded (On D11 Body)                               |
| S2       | 15S10183A82 | Housing, Connector; Male (3-Contact, Less Contacts), M5010/M7010   |          | 14S10157A30 | Insulator, Nylon (2-Req'd.); Mtg. P.C. Board                  |
|          | 39S10184A64 | Contact, Receptacle; 3 Req'd. for S2                               |          | 14S10550A02 | Insulator, Transistor Cover (Q9, Q15, Q17)                    |
| S3       | 15S10183A94 | Housing, Connector; Female (2-Contact, Less Contacts)              |          | 3S136050    | Screw, Tpg; 6-20x½ CLU Pan (Mtg. Q9, Q15, Q17 and D11 Socket) |
|          | 39S10184A72 | Contact, Receptacle; 3 Req'd. for S3                               |          | 9D25470A01  | Socket, CRT; Incl's. R77, R78, R79, R80                       |
|          |             |  |          | 9D25201A01  | Socket, H.V. and CRT Anode                                    |
|          |             |  |          | 9C63825A03  | Socket, Power Transistor Q9, Q15, Q17)                        |
|          |             |  |          | 41D65987A01 | Spring Special; CRT Aquadag Gnd.                              |



# TEC VIDEOELECTRONICS INC. SERVICE MANUAL

## A. GENERAL

TM-600 and TM-623 is a television monitor for video games. It is designed for operation either from a power supply of 115 volts/50–60 Hz AC or 230 volts/50–60 Hz AC. The complete monitor incorporates a picture tube, an integrated circuit, 20 silicon transistors, 18 silicon diodes, 2 germanium diodes, and a high-voltage selenium diode.

This model is equipped with 5V/3A power supply for the operation of the TTL control board and operation of double-pulse-type AFC circuit to obtain a stable picture.

## B. SPECIFICATIONS

### Power Supply Input

115 volts/230 volts 50–60 Hz  $\pm 10\%$

### Power Consumption

60 watts

### Video Input

0.5 volts composite P/P for 100 volts

2.5 volts P/P maximum

Sync negative at input

### Picture Tube

19" (500 mm), 114° deflection for Model TM-600

23" (584.2 mm), 114° deflection for Model TM-623

Integral implosion protection

### High Voltage

18 KV nominal at 0 microamperes beam current

### Horizontal Retrace Time

12 microseconds maximum

### Resolution

500 lines minimum at picture center

### Scanning Frequency

Horizontal: 15.750 Hz  $\pm 500$  Hz

Vertical: 50–60 Hz

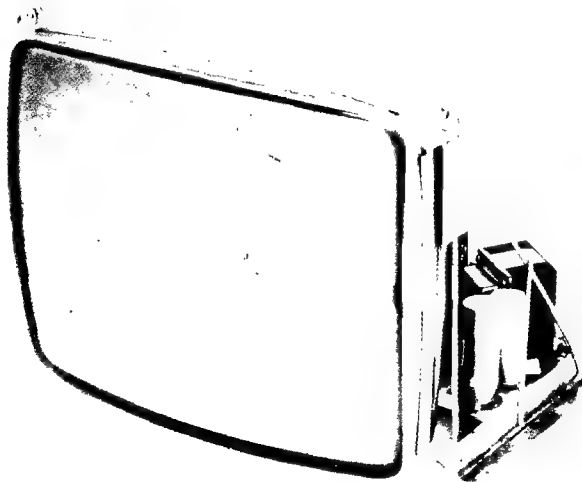
### Tone Burst Amplifier

5 watts peak output with TTL drive at nominal line, fully adjustable. 4 watts peak output at low line.

### Environment

Operation: Maximum ambient temperature 50°C (122°F)

Storage: Temperature range from –40°C to +65°C



Model TM-600 and TM-623 Monitors

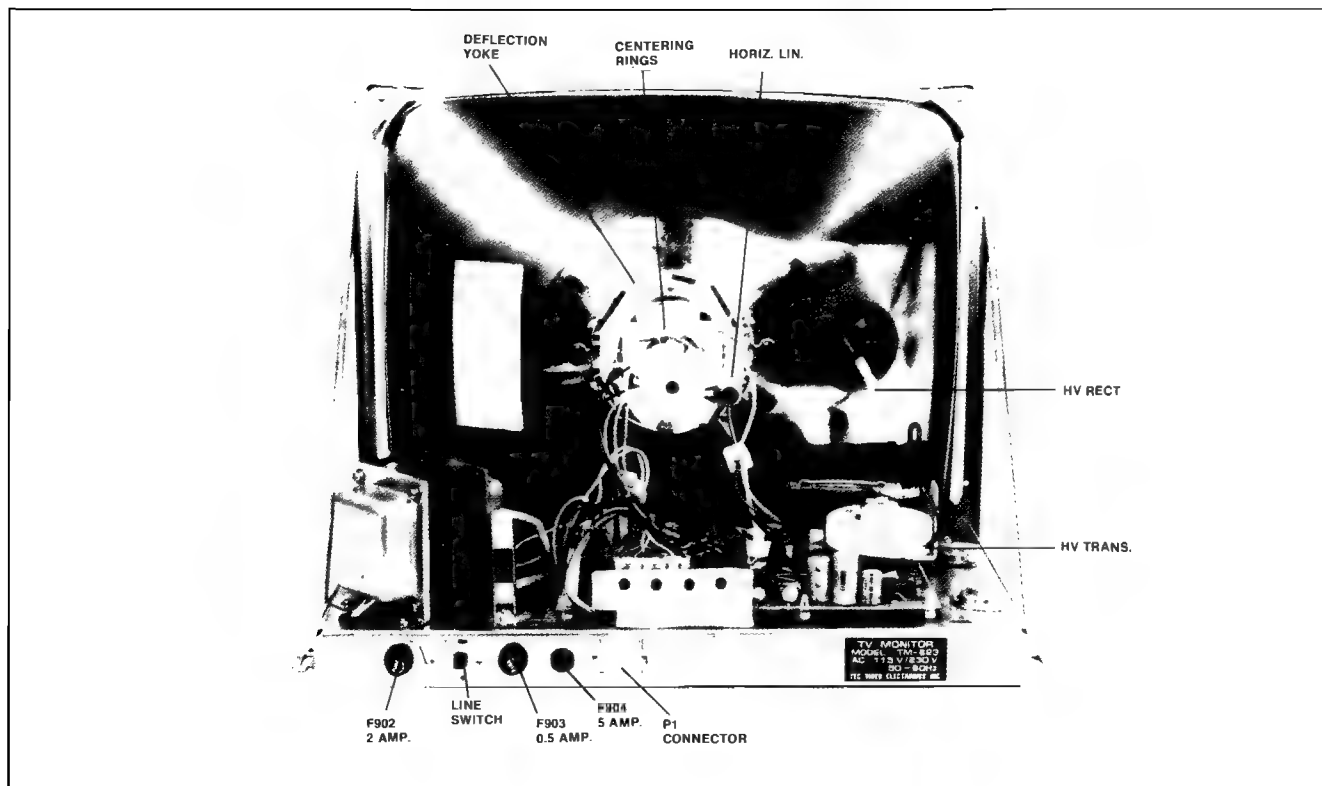


Figure 6-17 TEC Monitor Chassis, Rear View

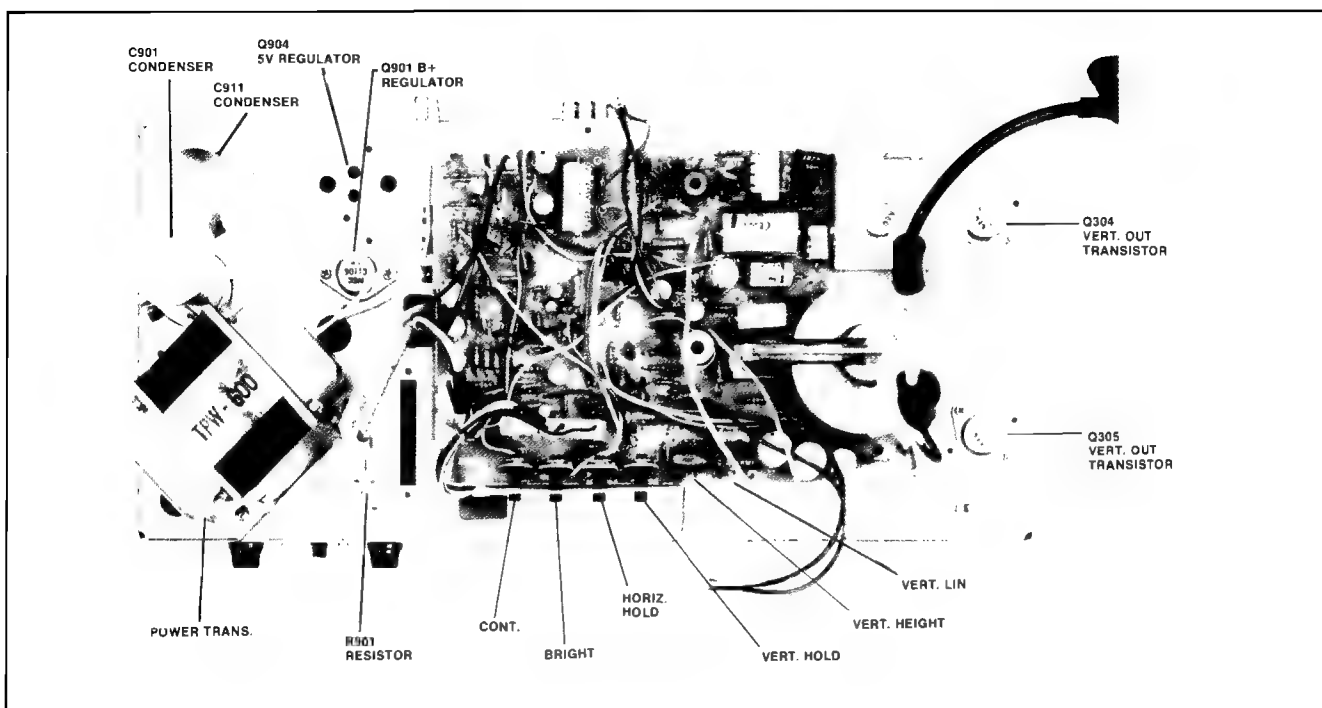


Figure 6-18 TEC Monitor Chassis, Top View

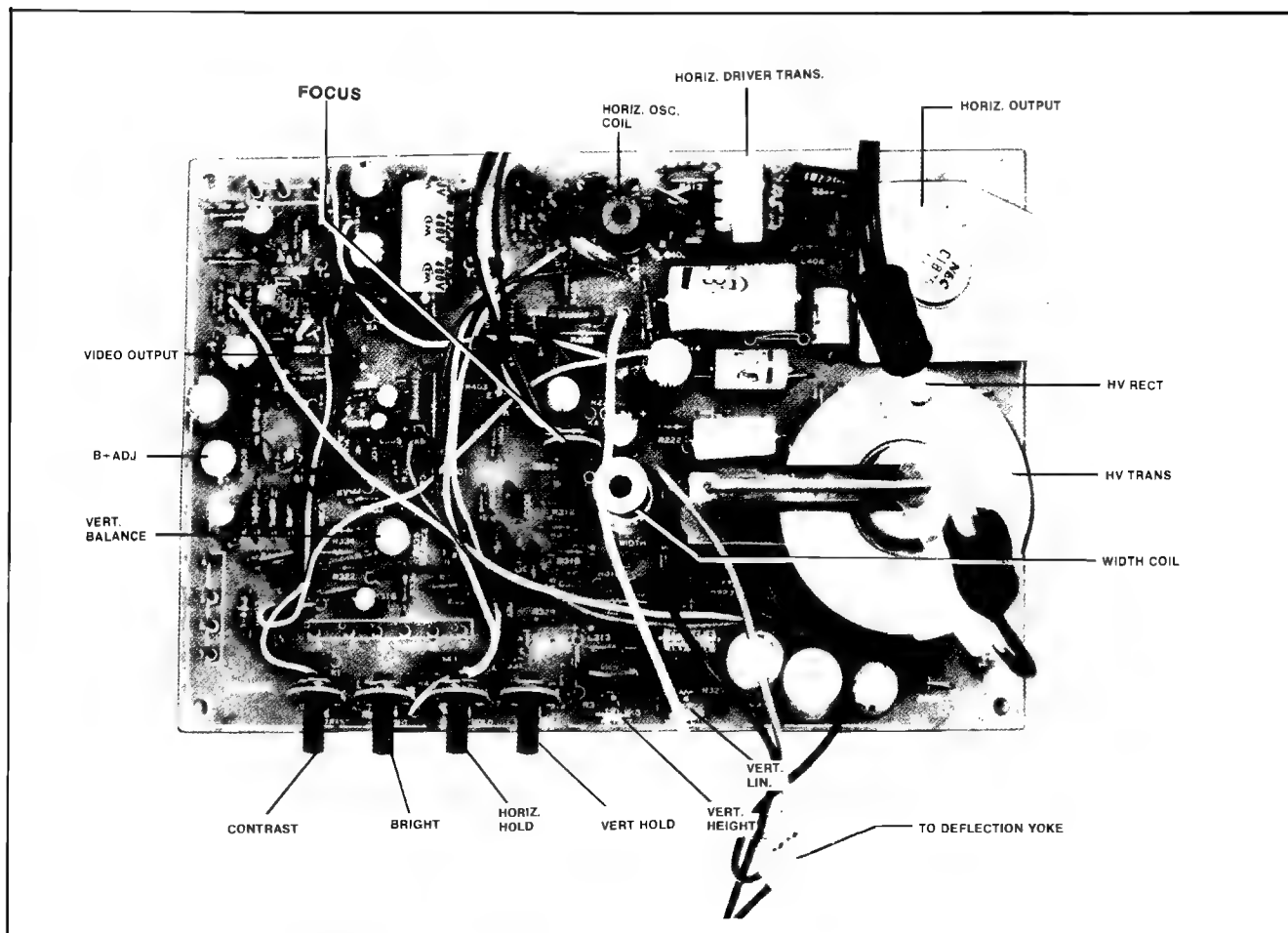


Figure 6-19 TEC Monitor Printed Circuit Board, Top View

Table 6-3 TEC Monitor Replacement Parts Numbers

| Ref. No.                  | Part No.   | Description                           | Ref. No. | Part No.   | Description                                 |
|---------------------------|------------|---------------------------------------|----------|------------|---|
| <b>Electrical Parts:</b>  |            |                                       | Q303     | 5300500201 | MPS9700U Vert Amp<br>or MPS834              |
| PCB1                      | 2215303600 | Main PCB                              | Q304     | 4310400030 | 2SC1106 Vert Output<br>or 2N6307            |
| A801                      | 485TM60003 | CRT PCB                               | Q305     |            |   |
| <b>Transistor and IC:</b> |            |                                       | Q400     | 5310500202 | MPS9700T Phase Inv<br>or MPS834             |
| Q200                      | 5310500202 | MPS9700T 1st Video Amp<br>or MPS834   | Q401     | 5310500202 | MPS9700T Horiz Osc<br>or MPS834             |
| Q201                      | 5310500261 | MPS9750T 2nd Video Amp<br>or MPS4356  | Q402     | 5310500410 | 2N6558 Horiz Amp<br>or MJE9742<br>or 2N4354 |
| Q202                      | 5310500410 | 2N6558 Video Output<br>or MPSU-10     | Q403     | 5310400040 | 2SC1875 Horiz Output<br>or MJ205            |
| Q301                      | 5310500261 | MPS9750T Sync Separator<br>or MPS4356 | *Q901    | 5310400030 | 2SC1106 Power Regulator<br>or MJ3430        |
| Q302                      | 5310500201 | MPS9700U Vert Osc<br>or MPS834        |          |            |   |

**Table 6-3 TEC Monitor Replacement Parts Numbers**

| Ref. No.                     | Part No.                    | Description              | Ref. No.                         | Part No.         | Description |             |             |
|------------------------------|-----------------------------|--------------------------|----------------------------------|------------------|-------------|-------------|-------------|
| Q902                         | 5310500410<br>or 5310500070 | 2N6558<br>MPS-U04        | Regulator Amp                    | T401             | 589514015   | TLN-506BX   | Horiz Osc   |
| Q903                         | 5310500280                  | LM1796<br>or MPS-D01     | Reference Amp                    | T402             | 589518012   | TLN-519     | Horiz Drive |
| Q904                         | 5310500450                  | MJ2955                   | 5V Regulator                     | * T403           | 589517017   | TFB-1006AS  | F.B.T.      |
|                              |                             |                          |                                  | * T901           | 589519021   | TPW-600     | Power Trans |
| <b>CRT and Diode:</b>        |                             |                          |                                  | <b>Resistors</b> |             |             |             |
| * V801                       | 5380000060                  | 500SB4                   | CRT                              | R201             | RD-4L471J   | 470 ohm J   | ¼ W         |
| D203                         | 5340200280                  | MR9712<br>or IN4004      | Silicon Diode<br>L. V. Rectifier | R202             | RD-4L223J   | 22 K ohm J  | ¼ W         |
| D204                         | 5340200430                  | IN4148<br>or IN4002      | Silicon Diode<br>Blanking Clip   | R203             | RD-4L563J   | 56 K ohm J  | ¼ W         |
| D205                         | 5340200430                  | IN4148<br>or IN4002      | Silicon Diode<br>Blanking Clip   | R204             | RD-4L471J   | 470 ohm J   | ¼ W         |
| D206                         | 5340200430                  | IN4148<br>or IN4002      | Silicon Diode<br>Blanking Clip   | R205             | RD-4L332J   | 3.3 K ohm J | ¼ W         |
| D207                         | 534020280                   | MR9712<br>or IN4004      | 200V Rect                        | R206             | RD-2L823J   | 82 K ohm J  | ½ W         |
| D301                         | 5340200260                  | MR-9701                  | Rectifier Silicon Diode          | R207             | RD-4L560J   | 56 ohm J    | ¼ W         |
| D401                         | 5340100040                  | AA143                    | Phase Det                        | R208             | RD-4L102J   | 1 K ohm J   | ¼ W         |
| D402                         | 5340100040                  | AA143                    | Phase Det                        | R210             | RS-029562J  | 5.6 K ohm J | 2 W         |
| D403                         | 5340200300                  | MR9722                   | Damper                           | R215             | RD-42101J   | 1 K ohm J   | ¼ W         |
| *D404                        | 5340400120                  | TV20-2K80J<br>or HS30/lb | H.V. Rectifier                   | * R216           | RD-4L101J   | 100 ohm J   | ¼ W         |
| D801                         | 5340200290                  | MR9713                   | 400V Rectifier                   | * R217           | RD-4L470J   | 47 ohm J    | ½ W         |
| D901                         | 5340200270                  | MR9704<br>or IN4005      | Rectifier<br>Silicon Diode       | R218             | RD-4L223J   | 22 K ohm J  | ¼ W         |
| D902                         | 5340200270                  | MR9704<br>or IN4005      | Rectifier<br>Silicon Diode       | R219             | RD-4L563J   | 56 K ohm J  | ¼ W         |
| D903                         | 5340200270                  | MR9704<br>or IN4005      | Rectifier<br>Silicon Diode       | R220             | RD-4L102J   | 1 K ohm J   | ¼ W         |
| D904                         | 5340200270                  | MR9704<br>or IN4005      | Rectifier<br>Silicon Diode       | R221             | RD-4L102J   | 1 K ohm J   | ¼ W         |
| D906                         | 5340300220<br>or 5340300310 | IN5858A<br>IN6002A       | Zener Diode                      | R222             | RD-2L102J   | 1 K ohm J   | ½ W         |
| D907<br>D908<br>D909<br>D910 | 5340200690                  | MDA970-1                 | Rectifier                        | R223             | RD-2L102J   | 1 K ohm J   | ½ W         |
| <b>Coils and Trans:</b>      |                             |                          |                                  | R224             | RD-2L122J   | 1.2 K ohm J | ½ W         |
| *L401                        | 589515015                   | TDY1005                  | D.Y. Coil                        | * R226           | RS01P101J   | 100 ohm J   | 1 W         |
| L402                         | 589512015                   | HCH1005                  | Horiz Choke Coil                 | R227             | RD-2L123J   | 12 K ohm J  | ½ W         |
| L403                         | 589512012                   | HC2-035                  | Choke Coil                       | R228             | RD-2L105J   | 1.5 K ohm J | ½ W         |
| L404                         | 589512012                   | HC2-035                  | Choke Coil                       | R229             | RD-4M681J   | 680 ohm J   | ¼ W         |
| L405                         | 589514013                   | AZ-9177DM                | Width Coil                       | R302             | RD-4M331J   | 330 ohm J   | ¼ W         |
| L406                         | 589514016                   | LH-15J54                 | Lin Coil                         | R303             | RD-4L562J   | 5.6 K ohm J | ¼ W         |
|                              |                             |                          |                                  | R304             | RD-4M102J   | 1 K ohm J   | ¼ W         |
|                              |                             |                          |                                  | R308             | RD-4M104J   | 100 K ohm J | ¼ W         |
|                              |                             |                          |                                  | R309             | RD-4M155T   | 1.5 Mohm J  | ¼ W         |
|                              |                             |                          |                                  | R310             | RD-4M332J   | 3.3 K ohm J | ¼ W         |
|                              |                             |                          |                                  | R311             | RD-4M563J   | 56 K ohm J  | ¼ W         |
|                              |                             |                          |                                  | R312             | RD-4L182J   | 1.8 K ohm J | ¼ W         |
|                              |                             |                          |                                  | R313             | RD-4L153J   | 15 K ohm J  | ¼ W         |
|                              |                             |                          |                                  | R314             | RD-4L183J   | 18 K ohm J  | ¼ W         |
|                              |                             |                          |                                  | R315             | RD-4L203J   | 20 K ohm J  | ¼ W         |
|                              |                             |                          |                                  | R316             | RS-2P333J   | 33 K ohm J  | ½ W         |
|                              |                             |                          |                                  | R327             | RD-4L104J   | 100 K ohm J | ¼ W         |
|                              |                             |                          |                                  | R320             | RD-4L124J   | 120 K ohm J | ¼ W         |

Table 6-3 TEC Monitor Replacement Parts Numbers

| Ref. No. | Part No.   | Description     | Ref. No.           | Part No.   | Description               |
|----------|------------|-----------------|--------------------|------------|---------------------------|
| R322     | RD-4L224J  | 220 K ohm J ¼ W | R904               | RD-2L123J  | 12 K ohm J ½ W            |
| R323     | RD-4L433J  | 43 K ohm J ¼ W  | R905               | RD-2L223J  | 22 K ohm J ½ W            |
| R324     | RD-4L471J  | 470 ohm J ¼ W   | R906               | RD-2L563J  | 56 K ohm J ½ W            |
| R326     | RD-4L152J  | 1.5 K ohm J ¼ W | R907               | RD-2L563J  | 56 K ohm J ½ W            |
| R339     | RD-4L101J  | 100 ohm J ¼ W   | R909               | RD-2L682J  | 6.8 K ohm J ½ W           |
| R331     | RD-4M331J  | 330 ohm J ¼ W   |                    |            |                           |
| R332     | RD-4L102J  | 1 K ohm J ¼ W   | <b>Controls:</b>   |            |                           |
| R333     | RS01P682J  | 6.8 K ohm J 1 W | R211               | 553102005E | 1 K ohm Contrast          |
| R334     | RD-2L183J  | 18 K ohm J ½ W  | R319               | 553104005B | 100 K ohm Vert. Hold      |
| R336     | RD-4L221J  | 220 ohm J ¼ W   | R321               | 553124008B | 220 K ohm Vert. Height    |
| R337     | 5160122901 | 2.2 ohm J ½ W   | R327               | 553472008B | 4.7 K ohm Vert. Linearity |
| R338     | RS-2P150J  | 15 ohm J ½ W    | R335               | 553102007B | 1 K ohm Vert. Balance     |
| R339     | 5160112901 | 1.2 ohm J ½ W   | R427               | 553303005B | 30 K ohm Horiz Hold       |
| R340     | RS01P220T  | 22 ohm J 1 W    | R803               | 553254005B | 250 K ohm Bright          |
| R401     | RD-4L153J  | 15 K ohm J ¼ W  | R805               | 553205005B | 2 M ohm Focus             |
| R402     | RD-4L821J  | 820 ohm J ¼ W   | R908               | 553472007B | 4.7 K ohm B+ADJ           |
| R403     | RD-4M561J  | 560 ohm J ¼ W   |                    |            |                           |
| R404     | RD-4M103J  | 10 K ohm J ¼ W  | <b>Capacitors:</b> |            |                           |
| R405     | RD-4M103J  | 10 K ohm J ¼ W  | C201               | CE2G1C470  | 47 mF 16V                 |
| R406     | RD-4L272J  | 2.7 K ohm J ¼ W | C202               | CE2G1F101  | 100 mF 25V                |
| R407     | RD-4L681J  | 680 ohm J ¼ W   | C203               | CE2G1C220  | 22 mF 16V                 |
| R408     | RS02P682J  | 4.7 K ohm J ½ W | C204               | CE2G1H101  | 100 mF 35V                |
| R419     | RD-4L270J  | 27 ohm J ¼ W    | C205               | CE2G1C220  | 22 mF 16V                 |
| R410     | RD-4L182J  | 1.8 K ohm J ¼ W | C206               | C1SL1H561K | 560 pF K 50V              |
| R411     | RD-4L151J  | 150 ohm J ¼ W   | C207               | CE2G0J221  | 220 mF 6.3V               |
| R412     | RD-4L561J  | 560 ohm J ¼ W   | C208               | 5270322401 | 0.22 mF M 400V            |
| R413     | RS01P682J  | 6.8 K ohm J 1 W | C209               | CE2G2F229  | 2.2 mF 315V               |
| R414     | RD-2L221J  | 220 ohm J ½ W   | C210               | CE2G1H220  | 22 mF 35V                 |
| R415     | 5160122903 | 2.2 ohm J 1 W   | C211               | CE2G1H339  | 3.3 mF 50V                |
| R416     | RD-2L569J  | 5.6 ohm J ½ W   | C213               | CK1F2H102K | 0.001 mF 500V             |
| R417     | RS02P182J  | 1.8 K ohm J 2 W | C220               | CE2G2F220  | 2.2 mF 250V               |
| R418     | RS01P123J  | 12 K ohm J 1 W  | C301               | CQ1M1H473K | 0.047 mF K 50V            |
| *R420    | RX05P220J  | 22 ohm J 5 W    | C304               | CK1B1H391K | 470 pF K 50V              |
| *R421    | RD-2L569J  | 5.6 ohm J ½ W   | C305               | CE2G1H478  | 0.47 mF 50V               |
| R422     | RD-4L153J  | 47 ohm J 1 W    | C306               | 56405333   | 0.033 mF K 50V            |
| R425     | RD-4L153J  | 15 K ohm J ¼ W  | C307               | CQ1M1H562K | 0.0056 mF K 50V           |
| R426     | 55337153   | 15 K ohm J ¼ W  | C308               | CQ1M1H273K | 0.027 mF K 50V            |
| R802     | RD-2L154J  | 150 K ohm J ½ W | C309               | CQ1M1H123K | 0.012 mF K 50V            |
| R804     | RD-2L474J  | 470 K ohm J ½ W | C311               | CQ1M1H124K | 0.12 mF K 50V             |
| R811     | RD-2L561J  | 2MΩ J ½ W       | C312               | CQ1M1H392K | 0.0039 mF K 50V           |
| *R901    | RX20P251J  | 250 ohm J 20 W  | C313               | DS5D1C229M | 2.2 mF 16V                |
| R902     | RD-2L101J  | 1 K ohm J ½ W   | C314               | CQ1M1H474J | 0.47 mF 50V               |
| R903     | RD-2L123J  | 12 K ohm J ½ W  | C315               | CQ1M1H333K | 0.033 mF K 50V            |
|          |            |                 | C316               | CF2G1A470  | 47 mF 10V                 |

**Table 6-3 TEC Monitor Replacement Parts Numbers**

| Ref. No.               | Part No.   | Description                       | Ref. No.   | Part No.   | Description                         |
|------------------------|------------|-----------------------------------|--|------------|-------------------------------------|
| C317                   | CE2G2A101  | 100 mF 100V                       | <b>Fuses:</b>  |            |                                     |
| C318                   | CK1E2H103K | 0.01 mF 500V                      | *F902  | 6990620011 | 250V 2 Amp.                         |
| C319                   | 5270310301 | 0.01 mF 630V                      | *F903  | 5990610013 | 250V 0.5 Amp.                       |
| C401                   | CQ1M1H103K | 0.01 mF K 50V                     | F904   | 5990630010 | 30V 5 Amp.                          |
| C402                   | CQ1M1H103K | 0.01 mF K 50V                     | <b>Mechanical Parts:</b>   |            |                                     |
| C403                   | CQ1M1H393K | 0.039 mF K 50V                    | *K001  | 22-463020  | Mate-N-Loc k Connector (AMP)        |
| C404                   | CK1B2H151  | 150 mF 500V                       |  | 60085005   | Edge Collector (Molex)              |
| C405                   | CE2G1H339  | 3.3 mF 50V                        |  | S-A3915    | Transistor Socket (SMK)             |
| C406                   | CQ1M1H104K | 0.1 mF K 50V                      | *TM60085001  |            | Fuse Holder                         |
| C407                   | CQ1M1H223K | 0.022 mF J 50V                    | or *TM60085001   |            | Fuse Holder                         |
| C408                   | CQ1M1H683K | 0.068 mF J 50 V                   | K005   | 1-380826-0 | Stand-Off Fastener (AMP)            |
| C409                   | CE2G1F470  | 47 mF 25V                         | P401   | PE19-1569  | 4P Plug Assy. (Yoke Line)           |
| C410                   | CK1B2H681K | 680 pF K 500V                     | P402   | PE19-1570  | 4F Recep Assy (Yoke Line)           |
| C411                   | CK1B2H222K | 0.0022 mF K 500V                  | P403   | PE19-1571  | 3P Connector Assy. (Video Input)    |
| C412                   | CK1B1H152K | 0.0015 mF K 50V                   | A621   | PE19-1572  | 4P Connector Assy. (Q901 Line)      |
| C413                   | CK1B1H102K | 0.001 mF K 50V                    | A631   | PE19-1573  | 6P Connector Assy. (Q304/Q305 Line) |
| *C414                  | CK1B3D471K | 470 pF K 2KV                      | P406   | PE19-1574  | 2P Plug Assy. (Heater Line)         |
| C415                   | CQ1M2A104K | 0.1 mF K 100V                     | P407   | PE19-1575  | 2P Recep Assy. (Heater Line)        |
| *C416                  | 5270333201 | 0.0033 mF 1.5KV                   | IE901  | PE19-1576  | Terminator, 6 Pin                   |
| C417                   | CE2G2C100  | 10 mF 160V                        | E001   | 135431015  | Ground Plate                        |
| C418                   | 5270333401 | 0.33 mF K 200V                    | F001   | 22-164001  | Frame                               |
| C419                   | 56635101   | 100 mF 35V                        | H003   | 5432001-1  | Plate Heat Sink A                   |
| C420                   | 56625471   | 470 mF 25V                        | Q403D  | 54320011   | Plate Heat Sink C                   |
| C801                   | 5270356302 | 0.056 mF K 630V                   |  |            |                                     |
| *C901                  | 5240700400 | 450 mF 200V                       |  |            |                                     |
| C902                   |            | 100 mF 160 V                      |  |            |                                     |
| C904                   | F2G2C229   | 2.2 mF 160V                       |  |            |                                     |
| C905                   | CK1F2H102K | 0.001 mF 500V                     |  |            |                                     |
| C911                   | 56625105   | 10000 mF 25V                      |  |            |                                     |
| C912                   | 56616018   | 1 mF 16V                          |  |            |                                     |
| <b>Discharge Gaps:</b> |            |                                   | <b>NOTE</b>  |            |                                     |
| Z801                   | 599030001  | EGP-H751A                         | 1. Design and specifications are subject to change without notice. |            |                                     |
| Z802                   |            |                                   | 2. J Indicates $\pm$ 5% tolerance                                  |            |                                     |
| Z803                   |            |                                   | K—Indicates +10% tolerance   |            |                                     |
|                        |            |                                   | M—Indicates +20% tolerance   |            |                                     |
| <b>Switches:</b>       |            |                                   |  |            |                                     |
| *SW-1                  | PE13-1567  | 115V/230V Power Line Slide Switch |  |            |                                     |



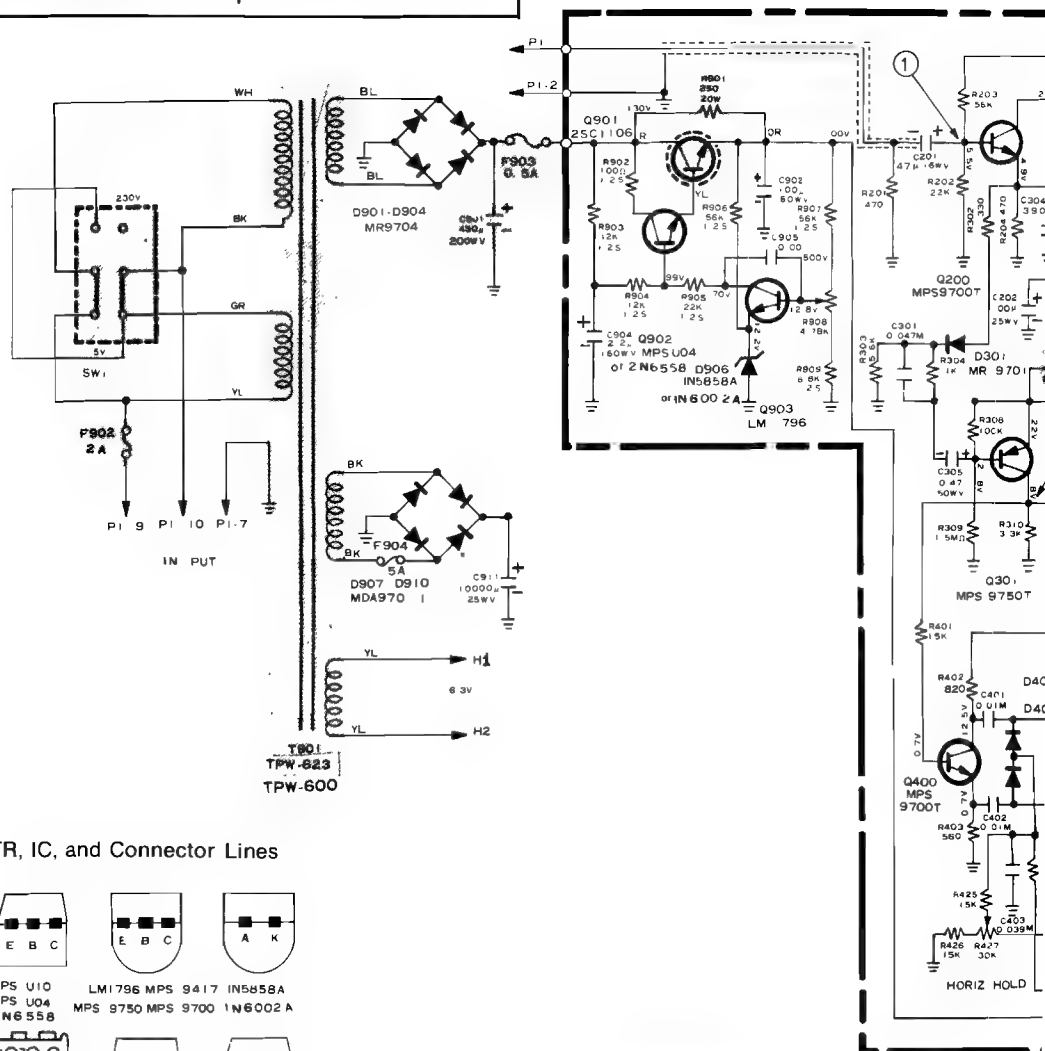


## WARNING

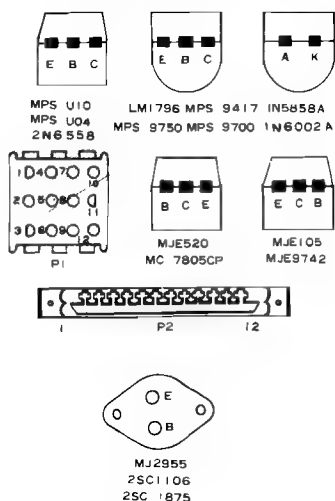
### Safety-Critical Components

Components marked with an asterisk (\*) on the parts list and with gray shading in the schematic have special characteristics important for safety.

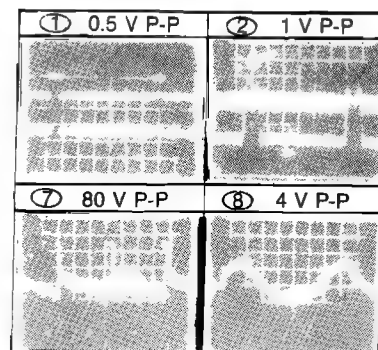
You may create shock, fire, or other hazards by using a replacement that does not have the same characteristics as the recommended part.



### TR, IC, and Connector Lines

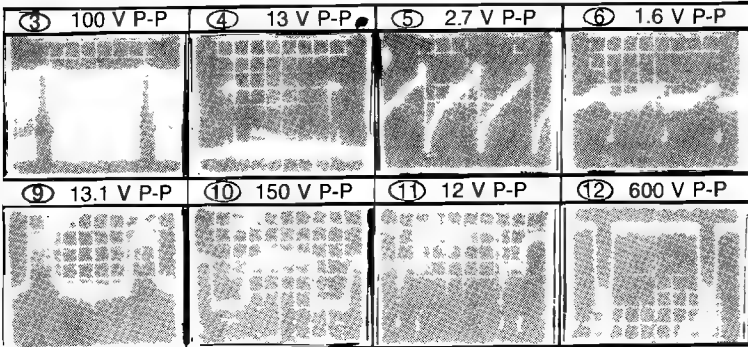
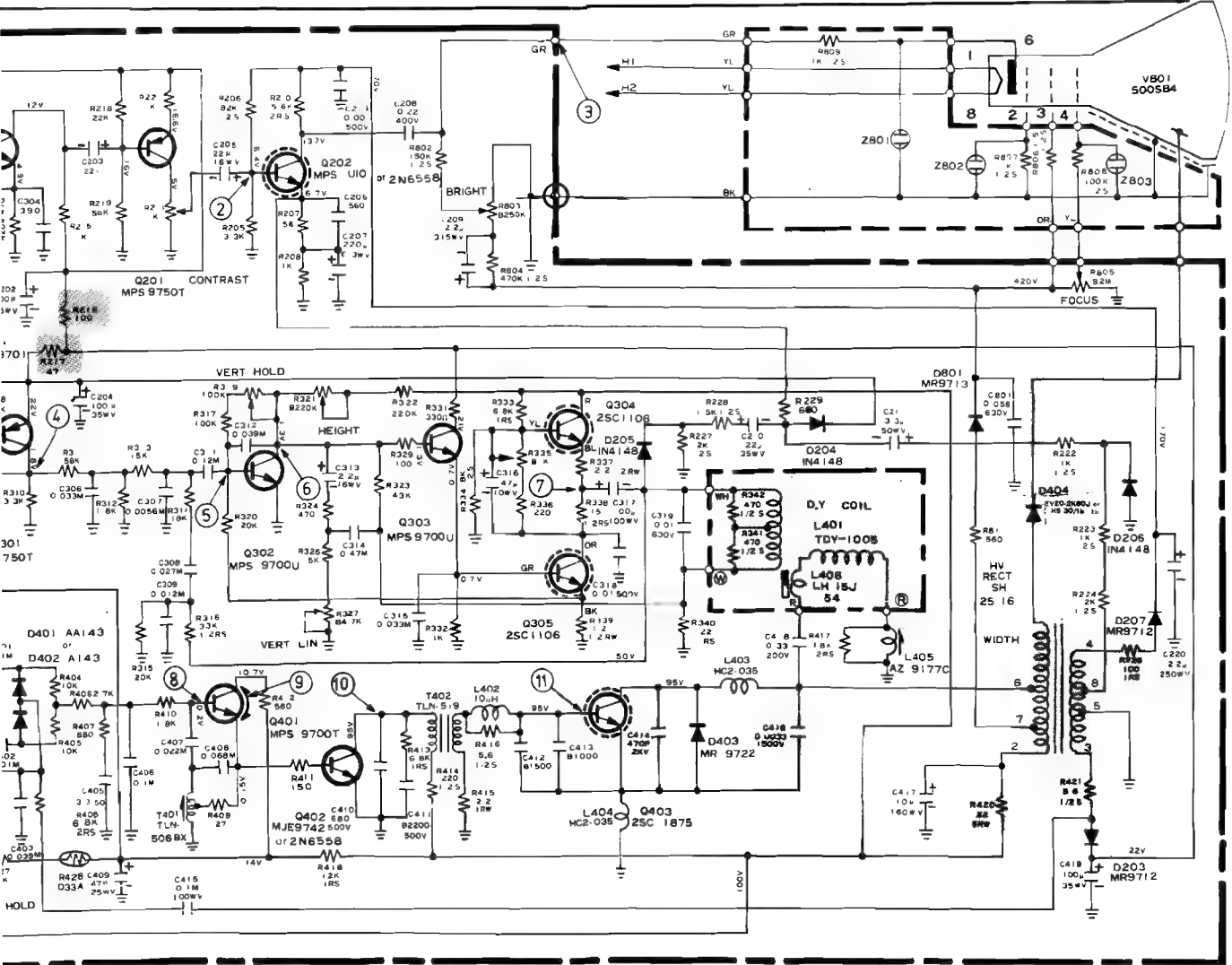


## WAVE FORMS

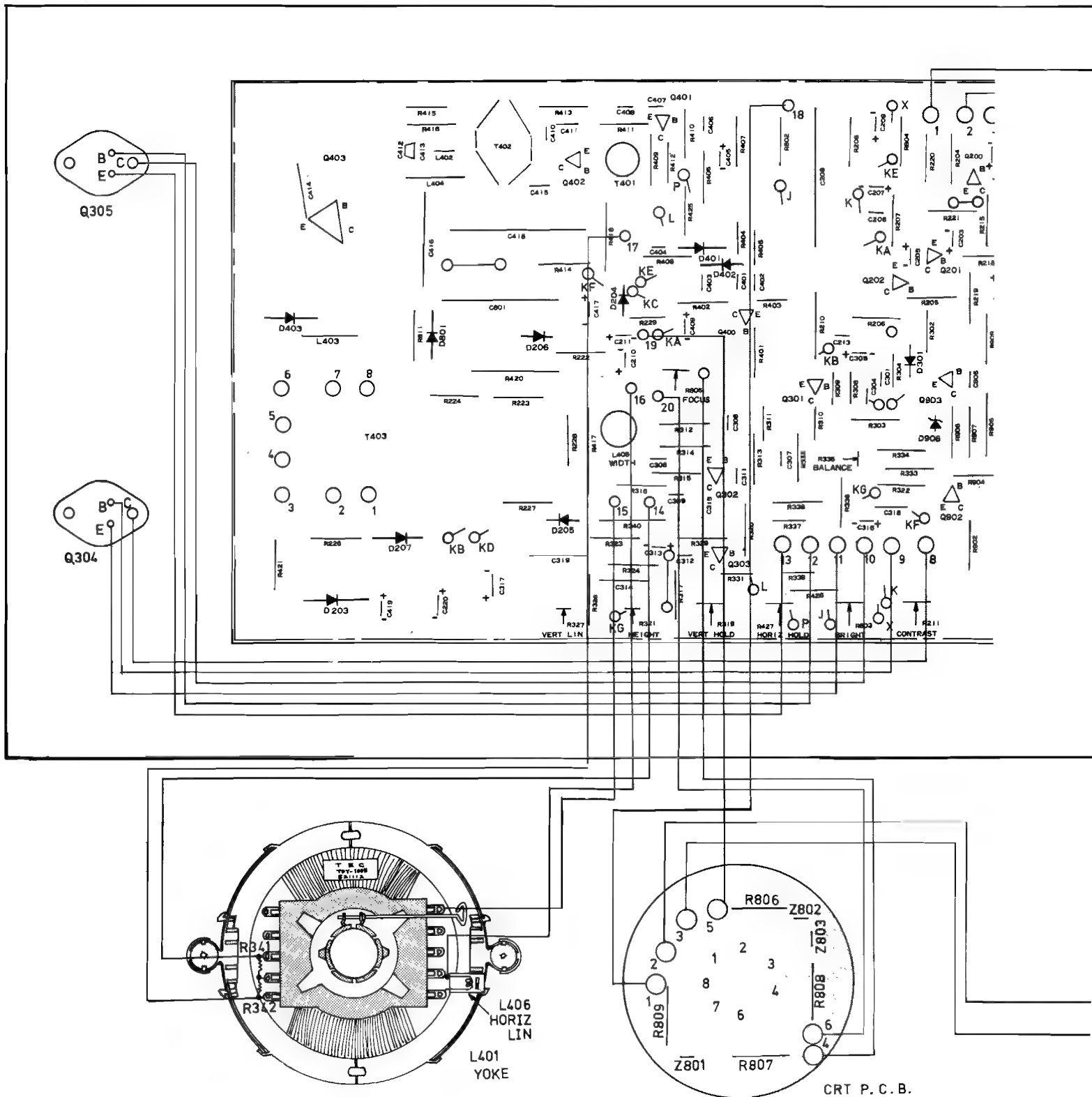


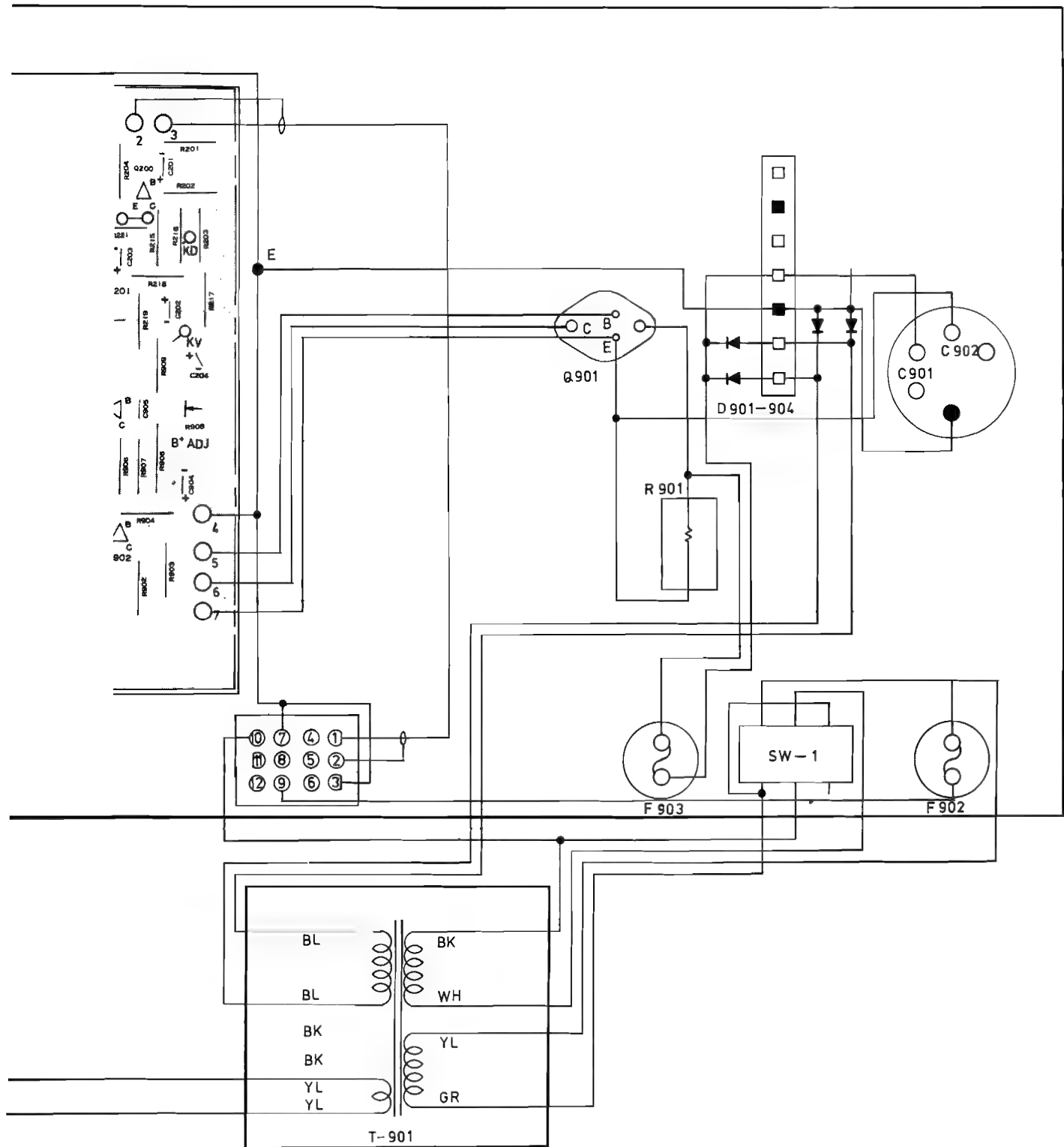
## NOTES

1. Unless otherwise specified, all resistance values are in ohms.
2. Unless otherwise specified, in the schematic diagram all capacitor values less than 1 are expressed in mfd, and values more than 1 are in pfd.
3. Voltage readings are taken with VTVM from point indicated on chassis to ground.
4. All waveforms are measured with strong signal input and contrast set to give normal picture.
5. This schematic diagram covers basic or representative chassis only. There *may* be some differences between actual components on chassis and the schematic diagram.



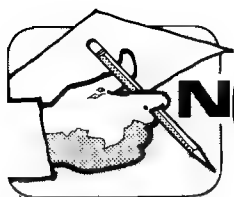
**Figure 6-20 TEC Monitor Schematic Diagram**





**BOTTOM VIEW**

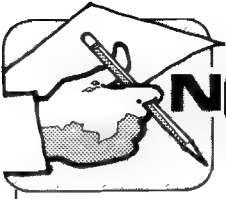
Figure 6-21 TEC Monitor Wiring Diagram



# NOTES



# NOTES



# NOTES

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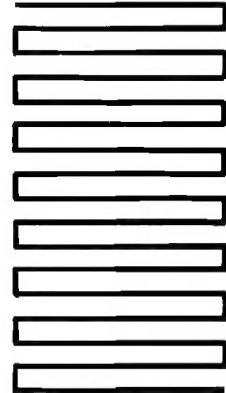
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